A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

DECEMBER, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

4426. New Researches on Element 93 in Natural State. H. Hulubei and Y. Cauchois. *Comptes Rendus*, 209. *pp.* 476–479, *Sept.* 18, 1939.—The best results were obtained from some betafites from Madagascar, tantalite-columbites and especially tantalite from Haute-Vienne, while indications were found in Brazilian monazite, Pt from the Urals and osmiridium from Tasmania. The line $L\alpha_1$, attributable to 93, was strengthened by precipitation of PtS_2 in the solution expected to contain it, the PtS_2 acting as a carrier. If its existence is finally confirmed the name *sequanium* is suggested. No trace of masurium, the presence of which in the same minerals as 93 might be expected, was found. C. A. S.

4427. Evidence for Skew Structure of Benzil. C. C. Caldwell and R. J. W. Le Fèvre. *Chem. Soc., J. pp.* 1614–1622, *Oct.*, 1939.—The suggestion is made that the stable configuration of benzil in non-polar solvents is one in which the ketonic groups, with their appropriate bonds, are effectively situated in, or make rotational oscillations of low amplitude about, two planes which are roughly mutually perpendicular. The evidence consists in the value of the dipole moment of benzil, the fact that this shows no greater dependence upon solvent than does the corresponding value for phenanthraquinone, and the observations that the moment is constant throughout a temperature range of 65° in decalin, or 25° in benzene or CCl_4. Other explanations of these data are discussed and rejected. Such a " skew " structure could arise if the dominant forces setting the shape of the molecule were superimposed dipolar repulsions between the $C=O$ moments and steric repulsions between the phenyl groups and O atoms (tending to a *trans*-structure) and van der Waals attractions between the phenyl groups (tending to a *cis*-structure). Compatibly with such a view diacetyl (in which dipolar repulsions should be much the same as, but the van der Waals attractions weaker than, in benzil) appears to be either much more flexible or more *trans* in type. AUTHORS.

4428. X-Ray Investigation of Decamethylene Series of Polyesters. C. S. Fuller and C. J. Frosch. *Am. Chem. Soc., J.* 61. *pp.* 2575–2580, *Oct.*, 1939.—Decamethylene polyesters of average molecular weight above 10000 have been prepared from the following acids: oxalic, succinic, glutaric, adipic, suberic, azelaic and sebacic. X-ray fibre patterns have been obtained on oriented fibres of these compounds. Complete measurements of the patterns are given and it is shown that in all cases the molecules conform closely to the planar zigzag model. Except in the case of the oxalate ester, all of the structures conform to the same lateral packing as is shown by the lower molecular chain compounds. A discussion of the origin of the various fibre patterns is given. It is shown that in the case of certain esters the presence of different crystal forms is indicated. A general interpretation of these forms on the basis of the theory of Schoon is presented. AUTHORS.

4429. Molecular Structure of Alkyl Halides. J. Y. Beach and D. P. Stevenson. *Am. Chem. Soc., J.* 61. *pp.* 2643–2651, *Oct.,* 1939.—Electron diffraction has been used to determine the molecular structures of ethyl chloride, ethyl bromide, isopropyl chloride, isopropyl bromide, methyl chloroform and isocrotyl chloride. The results are as follows:

Compound	C·Cl *distance* Å	C·C·Cl *angle*
Ethyl chloride	1·76 ± 0·02	111° 30′ ± 2°
Isopropyl chloride	1·75 ± 0·03	109 ± 3°
	C–Br	C–C–Br
Ethyl bromide	1·91 ± 0·02	109 ± 2°
Isopropyl bromide	1·91 ± 0·03	109° 28′ ± 3°
	C–Cl	C–C–Cl
Methylchloroform	1·76 ± 0·02	109 ± 2°
Isocrotyl chloride	1·72 ± 0·02	123 ± 2°

AUTHORS.

4430. Molecular Structure of Acetaldehyde. D. P. Stevenson, H. D. Burnham and V. Schomaker. *Am. Chem. Soc., J.* 61. *pp.* 2922–2925, *Oct.,* 1939.—From electron diffraction photographs of acetaldehdye the value 1·50 ± 0·02 Å has been found for the C–C distance. 1·22 ± 0·02 Å for the C–O distance, and 121 ± 2° for the C–C–O angle. It is suggested that in general the covalent carbon-oxygen double bond distance is about 1·21 Å instead of 1·24 Å. The structure of acetaldehyde is discussed briefly in terms of resonance among several valence-bond structures.

AUTHORS.

4431. Mobility of Saturated 6– and 7– Ring Systems and the Configuration of the 1 : 2-Cycloheptane Diols. J. Böeseken. *K. Ned. Akad. Wet., Proc.* 42. 7. *pp.* 573–580, 1939.—The author surveys previous work on this subject, and concludes that parts of molecules (atoms) may rotate round the bonds as axes and that by mutual repulsion of equal groups (*e.g.* OH groups) favoured positions are formed, owing to which fact the movements acquire the character of oscillations round those positions as points of oscillation. In the non-cyclic diols (in general) this point of oscillation has an unfavourable position for the formation of boro-complexes, and among the other possible positions there is only one which is highly favourable for this purpose. In the cyclopentane diols the rotating movement is almost entirely (but not completely) stopped, owing to the ring-closure; consequently the amplitudes of the oscillations of the OH groups have become small and in the cis-diols these remain favourable to the formation of boro-complexes; in the trans-diols very unfavourable for that purpose. In the cyclohexane diols the rotating movement has indeed decreased, owing to the ring closure, but the groups bound to the C-atoms can describe fairly large tracts. In the trans-diols, however, the OH groups remain constantly very unfavourable to the formation of boro-complexes; in the cis-diols the OH groups form two very favourable positions. In the cycloheptane diols the rotating movements are less inhibited and the area through which the groups of atoms may pass is still larger. Moreover, there is no position which is favoured by its energy conditions. In the trans-diol the vicinal OH groups may take a position which is moderately favourable to the formation of a boro-complex, while in the cis-diol there is a large favoured region. H. H. Ho.

See also Abstracts 4480, 4663.

COLLOIDS.

4432. Flow of Cream through Narrow Glass Tubes. G. W. Blair, J. C. Hening and A. Wagstaff. *J. Phys. Chem.* **43.** *pp.* **853–863,** *Oct.,* **1939.**—Creams—natural, homogenised, and reconstituted—were sheared through glass capillary tubes under pressure at a temperature of 37° C., and flow curves plotting the rate of shear against shearing stress were constructed. Five general types of flow curves were obtained. Type α : true fluids. The viscosity (η) is independent of stress and of the dimensions of the capillary. Type β : η is not independent of stress, but is independent of the dimensions of the capillary. In the majority of cases η falls with rising stress (structural viscosity), but in a few rare cases η rises with stress. Type γ : η is independent of stress, but is not independent of the dimensions of the capillary. In most cases a narrower or longer capillary shows a lower η (due to a breakdown in structure), but in a few cases the reverse occurs (type ϵ). Type δ : η is not independent of either stress or the dimensions of the capillary. In the case of systems which are not truly fluid, viscosities are defined under arbitrarily chosen conditions of stress and shear. A microscopic examination of creams was made for comparison with their rheological properties. Even an amount of breakdown induced by shearing which was too small to be observable microscopically could be demonstrated from the flow curves. Only in the case of comparatively drastic breakdown was there any visible change in the size of the clumps of fat globules. Preliminary comparisons of the flow curves of natural, homogenised, and reconstituted creams do not make it possible to distinguish the different types of cream, although certain general trends have been observed. It is hoped that further work may make possible some such more exact classification. AUTHORS.

See also Abstracts 4444, 4449, 4484, 4487, 4513, 4558, 4565.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

4433. Number of Configurations of an Assembly with Long-Distance Order. T. S. Chang. *Roy. Soc., Proc.* **173***A. pp.* **48–58,** *Nov.* **10, 1939.**—Starting from the equilibrium properties of an ideal alloy with a super-lattice of the type AB and with arbitrary compositions which are obtained by application of Bethe's method, the author has found the partition function of the alloy by a process which is simply the reverse of deducing the equilibrium properties from the partition function. It is shown that if this partition function is expanded in powers of $(KT)^{-1}$, it agrees with the corresponding rigorous expression up to the power $(KT)^{-8}$. From this partition function, an approximate expression is found for the number of ways of arranging $\frac{1}{2}$ N$(\theta + \theta')$ particles upon a lattice of the type AB consisting of N sites in total ; with $\frac{1}{2}$Nθ particles on one sublattice and $\frac{1}{2}$Nθ' particles on the other, producing X pairs of nearest neighbours formed by the particles. The exact value of this number is evaluated for the special case in which the N sites are on a straight line, and is found to agree with the approximate formula exactly. [See Abstract 1882 (1939).] AUTHOR.

4434. Scattering of X-Rays and Electrons by Crystals. J. M. Bijvoet and C. H. MacGillavry. *Ned. T. Natuurk.* **6. 15.** *pp.* **261–274,** *and* **6.16.** *pp.* 281–299, **1939.**—The kinematic theory of Laue and the dynamic theory of Darwin deal with the scattering of X-rays by crystals. In the dynamic theory the crystal as a mosaic is considered. In the kinematic theory one unit-cell only is considered and a structure factor S, which depends on the position of the atoms, and an atom form factor F depending on the electronic arrangement within the atom, are derived. The final expression also involves a Lorentz factor which accounts for the ordinary falling off of the intensity of the scattering with angle. The usual procedure of crystal analysis is described—the determination of the size of the unit cell and the symmetry of the crystal. The positions of the atoms in the cell can be determined by a consideration of the intensity of various reflected beams and of the structure factors. There are two ways of doing this—Fourier analysis and Patterson's analysis. These methods are discussed in some detail. In the second part of the paper, the results of certain crystal analyses are mentioned—the determination of the Avogadro number, information as to valency, the structures of olivine, mica, etc., and fibrous texture. Data are also given concerning the scattering power of the atoms as expressed by the so-called F curves; these are considered for Na^+, Li^+, Cl^- and H^-. The question of dispersion and the work of H. Kallmann and H. Mark [see Abstract 2303 (1927)] are discussed. The last section deals with the diffraction of electron streams by crystals and the results obtained from gold foil, mica and pyrites as well as the theory of the phenomenon are considered. G. G.

4435. Solubility and Structure of PbP_2O_7. G. Peyronel. *Gazz. Chim. Ital.* 69. 4. *pp.* 254–262, *April*, 1939.—The preparation of a chemically and thermally stable plumbic pyrophosphate by dissolving PbO_2 in H_3PO_4 at 300 ° C. is described, and qualitative results for its solubility in pure water, weak acids and alkalies reported. With *Kα*Fe radiation ($\lambda = 1\cdot934$ Å), with 30–40 kV and 10–15 mA, a is found to be $8\cdot01 \pm 0\cdot01$ Å, with Pb in (000) positions, O_{II} in $(\frac{1}{2}\,\frac{1}{2}\,\frac{1}{2})$, P in $(u\,u\,u)$, and O_I in $(x\,y\,z)$, and corresponding coordinate numbers of 6, 2, and 4; Pb ions are thus arranged in a face-centred cube, while $P_2O_7^{IV}$ ions are in the form of a double tetrahedron with the central O at the nodes of another face-centred cubic lattice at a distance $a/2$ along the principal x, y, z axes. From this the calculated density is 4·935 and the substance belongs to the group $T_h^6 - Pa3$, $z = 4$. Corresponding lattice constants are 7·90 and 8·20 Å for pyrophosphates of Sn and Zr respectively. D. R. H.

4436. Redetermination of F-F Distance in KHF_2. L. Helmholz and M. T. Rogers. *Am. Chem. Soc., J.* 61. *pp.* 2590–2592, *Oct.*, 1939.—A redetermination of the parameter in KHF_2 has been carried out using Laue and oscillation photographs. The value $u = 0\cdot1408 \pm 0\cdot003$ leads to the F–F distance $2\cdot26 \pm 0\cdot01$ Å in $\{F\text{–}H\text{–}F\}^-$. A comparison is made with other reported values. AUTHORS.

4437. Structures of Complex Fluorides. J. L. Hoard and W. B. Vincent. *Am. Chem. Soc., J.* 61. *pp.* 2849–2852, *Oct.*, 1939.—It is deduced from X-ray data that crystals of the isomorphous ammonium and potassium fluogermanates possess one-molecule hexagonal units of structure with $a = 5\cdot85$ Å, $c = 4\cdot775$ Å and $a = 5\cdot62$ Å, $c = 4.65$ Å, respectively, space-group D_{3d}^3–C3 *m*. The structure is an aggregate of univalent kations (K^+, NH_4^+) and nearly regular octahedral anions (GeF_6^{-4}) with Ge–F = 1·77 Å. Each kation is surrounded by 9 nearly equidistant F atoms and three others at somewhat greater distances. This structure has been found only in the case of complex fluorides, for which at ordinary temperatures it is usually preferred to the cubic ammonium chloroplatinate structural type. AUTHORS.

4438. Structure of Potassium Molybdocyanide Dihydrate. J. L. Hoard and H. H. Nordsieck. *Am. Chem. Soc., J.* 61. *pp.* 2853–2863, *Oct.*, 1939.—It is shown from X-ray data that the orthorhombic unit cell in crystals of $K_4Mo(CN)_8$, $2H_2O$ contains four molecules with $a_0 = 16 \cdot 55$ Å, $b_0 = 11 \cdot 70$ Å, $c_0 = 8 \cdot 68$ Å, space-group D_{2h}^{16}–$Pnma$. Patterson projections on the three axial planes together with Patterson-Harker summations calculated from visually estimated intensity data were used to obtain approximate coordinates for Mo and K. These data were sufficient to determine the phases of the more important ($hk0$) and ($h0l$) reflection amplitudes so that incomplete Fourier projections on (001) and (010) could be calculated. Recalculation and refinement of these projections by familiar methods of successive approximations lead to the complete determination of the structure. Parameter data account satisfactorily for the intensities of X-ray reflections and lead to generally reasonable interatomic distances. The structure is an aggregate of K^+ ions, $Mo(CN)_8^{-4}$ ions, and water molecules. The configuration of the $Mo(CN)_8$ group seems to be stereochemically very reasonable. The $Mo(CN)_8$ polyhedron is a duodecahedron with eight vertices and triangular faces. Although required by the space group to possess only a plane of symmetry, the complex ion in the crystal approximates to the symmetry of the point group D_{2}^{d}–$\bar{4}2m$. AUTHORS.

4439. Variation in Structure of Water in Ionic Solutions. G. W. Stewart. *J. Chem. Phys.* 7. *pp.* 869–877, *Oct.*, 1939.—It has been long thought that the presence of ions in an aqueous solution produces a contraction of the water. Here it is shown by X-ray diffraction curves (1) that with concentration of ions there is a lessening of the amount of the 4-coordinated water structure, increasing the density, (2) that the alteration in structure is apparently similar to that produced by increasing the temperature of the water, and (3) that the effect on the water structure is not confined to the shell immediately adjacent to an ion. Further, by the use of 15 strong electrolytes, selected because of their wide variation in type and also in apparent molal ionic volume, it is shown by measurements on the alteration in the minor diffraction peak that the rate of variation of the liquid structure of the water with ionic concentration has a striking correspondence with the rate of variation of the apparent molal ionic volume. In fact, the alteration in liquid structure seems to have a much more important effect in the apparent molal ionic volume than has an electrostatic theory based on the Debye-Hückel theory. [See also Abstract 4763 (1938).] AUTHOR.

4440. X-Ray Diffraction in Liquid Ethyl Alcohol. G. G. Harvey. *J. Chem. Phys.* 7. *pp.* 878–880, *Oct.*, 1939.—X-ray diffraction patterns of liquid ethyl alcohol have been taken at temperatures of 25° C. and − 75° C. with monochromatic Mo $K\alpha$ radiation out to values of $(\sin \theta)/\lambda = 1 \cdot 2$ and Fourier analyses of these curves carried out. The weighted radial atom distribution function shows a number of well-defined peaks. The first of these, at about 1·5 Å, corresponds to the C–C (1·54 Å) and C–O (1·43 Å) distances in the molecule, the two being superposed. This composite peak is completely resolved from the remainder. A peak at about 2·4 Å may be interpreted as due to the other C–O distance in the molecule. These are the only definite distances, corresponding to permanent neighbours, that would be expected. A most interesting feature is the existence of a peak at about 2·9 Å corresponding to intermolecular linkage of hydroxyl groups, similar to the situation found in liquid methyl alcohol. The area under this peak shows that each hydroxyl is linked to, roughly, two others, as was also found to be the case for methyl alcohol. Beyond this there are no very definite distances, the density curve rapidly approaching the average density. AUTHOR.

4441. Molecular Distribution in Liquids. J. G. Kirkwood. *J. Chem. Phys.* 7. *pp.* 919–925, *Oct.*, 1939.—A theory of the radial distribution function in nonpolar liquids composed of spherical molecules is developed. The characteristic features of experimentally determined radial distribution functions are reproduced by the theory. A single parameter, the work of formation of a cavity of molecular size, determines the approximate form of the distribution. AUTHOR.

4442. Effect of Temperature on Structure of Mercury. R. N. Boyd and H. R. R. Wakeham. *J. Chem. Phys.* 7. *pp.* 958–962, *Oct.*, 1939.—X-ray diffraction patterns of Hg at eight temperatures ranging from – 36° C. to 250° C. have been obtained using Mo $K\alpha$ radiation. The X-ray beam was diffracted from an open Hg surface using the small angle of incidence of 4° 11′, thus permitting observation of a previously unreported peak at a diffraction angle of about 10°. Fourier analyses of the intensity curves gave distribution functions showing the expected shifting and broadening of the maxima with increasing temperature. A small subsidiary peak, which changes position with temperature more rapidly than the others, occurs between the first and second main concentrations of atoms. AUTHORS.

4443. Crystallisation by Pulverisation. W. Dekeyser and J. A. Prins. *Physica*, 6. *pp.* 1009–1010, *Oct.*, 1939. *In French.*—Large pieces of vitreous Se, maintained at 48° for 2–3 weeks, show no sign of crystallisation, but if previously pulverised they do so, imperfectly after a week, more perfectly after 2 to 3 weeks. This is not affected by the heating being carried out in H_2O_2, air, a vacuum with or without P_2O_5 or Na, or under C_6H_6; but it is probably a result of deformation due to the pulverisation. [See Abstract 4823 (1937).] C. A. S.

See also Abstracts 4490, 4494, 4598, 4599, 4604, 4610 and
2480B. Relations between Crystal Structure and Corrosion. G. Derge.
2484B. Lattice Spacing of Mg at High Temperatures. G. V. Raynor and W. Hume-Rothery.

DIFFUSION AND OSMOSIS.

4444. Diffusion in Colloidal Media. J. M. Reiner. *Math. Biophysics, Bull.* 1. *pp.* 142–149, *Sept.*, 1939.—When the molecules of a solute diffuse through a medium containing large colloidal particles, which absorb the diffusing molecules, the latter are transported in the diffusion flow not as free molecules, but as absorption compounds: solute + colloid. When the colloidal particle is much larger than the molecule of the solute, and has therefore a much smaller mobility, this results in a reduction of the apparent diffusion coefficient for the solute. The biological implications of this are discussed. AUTHOR.

4445. Hole Theory of Diffusion. R. P. Johnson. *Phys. Rev.* 56. *pp.* 814–818, *Oct.* 15, 1939.—The activation energy Q_s for diffusion in a dilute metallic solution cannot be less than the activation energy Q_0 for self-diffusion, if the solute atoms can move only through the medium of " holes " which diffuse to them from the solvent lattice, displace them, and leave in another direction. Since the experiments show that generally $Q_s < Q_0$ an alternative mechanism is required. Solute atoms which are not so firmly bound in the lattice as are solvent atoms will tend to trap holes to form solute-hole molecules. These molecules can move as units through the dense solvent lattice by cycles of inversion and re-orientation. This mechanism yields for the diffusion constant the value $D = A^* \exp[-(W + S)/RT]$, where W is the energy required to form a hole adjacent to a solute atom, and S is the activation energy for re-orientation or inversion of a solute-hole molecule. Q_s ($\equiv W + S$) may be much smaller than either Q_0 or the binding energy of the solvent. A^* should be significantly less than the corresponding A for self-diffusion. Both these predictions are in accord with the data. The same considerations should apply also to diffusion in liquids. AUTHOR.

4446. Diffusion of Gases Through Metals from a Chemical Point of View. J. H. Simons and W. R. Ham. *J. Chem. Phys.* 7. *pp.* 899–902, *Oct.*, 1939.—The diffusion of gases through metals is considered from the point of view of chemical compounds between the metal or a constituent of it and the gas, all at chemical equilibrium. Without reference to the surface conditions the usual laws of diffusion are derived, and Fick's linear diffusion law is shown to be a consequence of the hypothesis. Cases are treated where one compound between the gas and metal is formed, where two compounds are formed, where one compound is formed between the metal and gas and another formed between an alloying agent and the gas, and where the same compound is formed but the metal has a transition between two forms. The theory correlates the magnitude of the exponent of the gas pressure in the diffusion isotherms with the chemical reactions within the metal. It also leads to certain consequences in regard to the magnitude of the diffusion and the energy of activation. [See following Abstract.] AUTHORS.

4447. Diffusion of Hydrogen Through Oxygen-Free Copper. W. R. Ham. *J. Chem. Phys.* 7. *pp.* 903–907, *Oct.*, 1939.—A precise determination has been made of the diffusion of H_2 through Cu that is spectroscopically oxygen-free. The range of temperatures is from 450° C. to 1050° C. The Cu appears perfectly homogeneous over the entire range, the equation followed being: Rate $= Ap^yT^ze^{-b/T}$, where p is pressure, T absolute temperature, A and b constants characteristics of Cu. The value of z is about $+0{\cdot}5 \pm 0{\cdot}2$ as was found in pure Ni. The principal point to be noted is that $y = 0{\cdot}50 \pm 0{\cdot}01$ even at 450° C. It is well known that Cu containing any appreciable amount of O_2 shows isotherms in this region with a value of y as large as $0{\cdot}8$ in some instances, when log R is plotted against log p. When this same Cu diffusor is slightly charged with O_2 the value of y becomes greater than $0{\cdot}5$, except at high temperatures. However, when isotherms are plotted log rate against log pressure, the result is a perfectly straight line in all cases. It now appears that the removal of all traces of O_2 from Cu has the same effect on low temperature H_2 diffusion isotherms as the removal of all C from Fe and Ni, *viz.*, these isotherms become perfectly normal, the rate varying exactly as the square root of the pressure. [See preceding Abstract.] AUTHOR.

4448. Variation of Differential Diffusion Constant of HCl with Temperature. W. A. James and A. R. Gordon. *J. Chem. Phys.* 7. *pp.* 963–965, *Oct.*, 1939.—The differential diffusion constant of HCl has been determined at temperatures ranging from 10° C. to 35° C. At 10° and at 15°, the variation of the diffusion constant with concentration is given by the relation $k = k_0(1 + c\partial \ln f/\partial c)\cdot(\eta_0/\eta)$ only up to about $0{\cdot}2\,N$. The activation energy of diffusion for concentrations less than $0{\cdot}2\,N$ is practically independent of acid concentration; it decreases with increasing temperature, and is of the order of magnitude of the activation energy of viscous flow. For higher concentrations, the activation energy increases with increasing acid concentration. [See Abstract 931 (1939).] AUTHORS.

See also Abstracts 4455, 4477.

ELASTICITY AND PLASTICITY.

4449. Equilibrium of Thin Compressible Membrane with Application to the Periodontal Membrane. G. E. Hay. *Canad. J. of Research,* 17. *Sect. A. pp.* 123–140, *July,* 1939.—The equilibrium of a thin compressible elastic membrane has been previously considered [see Abstract 3522 (1939)]. In the present work the theory is applied to the periodontal membrane which lies between the tooth and the jaw-bone. For simplicity, a tooth is considered of which the root is a right circular cone, the thickness of the membrane being assumed constant. A load is applied to the tooth in a plane containing the axis of the root and a determination is made of the resulting stress in the membrane and displacement of the tooth. It is also found that the periodontal membrane holds the tooth in place in a way different from that commonly accepted by dentists. AUTHOR.

4450. Elastic Forces Around a Horizontal Gallery of Circular Section. P. Despujols. *Comptes Rendus,* 209. *pp.* 549–551, *Oct.* 9, 1939.—Expressions are derived for the elastic forces called into play by driving a rectilinear, horizontal gallery (as in mining) of circular cross-section into a homogeneous, isotropic medium, *e.g.,* the earth. J. S. G. T.

4451. Photoelastic Constant of Rock-Salt Crystals. Y. Kidani. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 457–460, *Aug.,* 1939. *In English.*—The reversibility of the photoelastic effect shown by a rock-salt crystal of dimensions $1 \cdot 82 \times 1 \cdot 50 \times 1 \cdot 04$ cm. is established in the elastic region for a first cycle of loads from $0 \sim 13 \cdot 2$ gm./mm^2. In a second loading permanent set appears at a load of 19 gm./mm^2. The phenomena are similar to those exhibited by a metal passing from the elastic to the plastic state. Values of the photoelastic constant deduced from the results agree with results obtained by Maris [see Abstract 235 (1928)], and are discussed in terms of a theory which resolves the coefficient into linear and quadratic terms when expressed in terms of the stress. J. S. G. T.

4452. Asymptotic Properties of the Fundamental Functions in the Problem of the Vibrations of an Elastic Solid. A. Pleijel. *Arkiv f. Mat. Astron. och Fysik, Stockholm, 26A.* 19. [9 *pp.*], 1939. *In French.*—Obtains the order of magnitude of the functions occurring in the expansion of Green's function for the vibrations of an elastic solid with a rigid boundary. W. G. B.

See also Abstracts 4471, 4636, 4638, 4639 and
2676B. Vibration of Helical Springs. R. M. Davies.
2707B. Composite Nature of Stress-Strain Curve of Rubber. I. Williams and B. M. Sturgis.

HYDRODYNAMICS AND AERODYNAMICS.

4453. Similitude of Phenomena of Entrainment of Air by Water in Motion. L. Escande. *Comptes Rendus,* 209. *pp.* 626–627, *Oct.* 23, 1939.—In continuation of previous work [see Abstract 2672 (1932)] the author shows that the principle of similitude is, theoretically, not applicable to systems comprising a free surface subjected to atmospheric pressure, even if it be assumed that perturbations attributable to viscosity are negligible owing to turbulence, and if the effect of surface tension is not taken into account. The case of the entrainment of air by a stream of water is discussed in illustration of this contention. J. S. G. T.

4454. Speed of Surface Wave-Train on Water. J. Baurand. *J. de Physique et le Radium*, 10. *pp.* 420–422, *Sept.*, 1939.—A signal consists of a train of surface waves on water of frequency 50 and of wavelength 0·59 cm. An optical device together with a photo-cell is employed to measure the speed of the beginning and end of the train by noting the time of passage at two given points. Values of the speed depend on the mode of production of the waves. One type had a velocity of 35 cm./sec. at the front and 56 cm./sec. at the rear of the wave-train. G. C. McV.

KINETIC THEORY OF MATTER.

4455. Transport Phenomena in Mixtures of Gases. E. J. Hellund and E. A. Uehling. *Phys. Rev.* 56. *pp.* 818–835, *Oct.* 15, 1939.—The theory of transport in gases taking into account the full effect of quantum statistics is extended to include mixtures as well as one-component gases. The method of Lorentz, Hilbert and Enskog, which was used previously in the development of the quantum theory of transport in a single component gas, is used again in this more general case. As is to be expected, all transport equations have formally the same dependence on velocity, temperature and pressure gradients as in the classical statistics, the effects of diffraction and interference introduced by the quantum statistics appearing only in the coefficients themselves. Expressions for the viscosity, heat conductivity, pressure diffusion, and thermal diffusion coefficients into which assumptions with regard to the interaction laws may be introduced have been obtained It is expected that these expressions may form the basis for calculation based on plausible assumptions as to the interaction that will provide a relatively good test of these laws as well as of the theory itself. AUTHORS.

See also Abstracts 4578.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

4456. Integral Occurring in Cascade Theory of Cosmic-Ray Showers. D. R. Hartree. *Manchester Lit. & Phil. Soc., Mem.* 83. *pp.* 175–182, *Aug.*, 1939.—[See Abstracts 2076 (1937), 643 (1938) and following Abstract.]

4457. Function $\chi(x) = \int_0^\infty e^{-(x-w^2)^2}\,dw$. **D. R. Hartree and S. Johnston.** *Manchester Lit. & Phil. Soc., Mem.* 83. *pp.* 183–188, *Aug.*, 1939.—[See preceding Abstract.]

See also Abstracts 4453, 4496, 4523, 4621.

MECHANICS, CLASSICAL.

*** 4458. Piezoelectric Dynamometer for Measurement of Impulsive Forces. N. Andreevskij.** *J. Techn. Phys. U.S.S.R.* 9. 8. *pp.* 680–686, 1939. *In Russian.*—A dynamometer is described in which the impulsive force is applied to quartz plates. The consequent change of potential of a collector plate is recorded on an oscillograph after amplification. The use of the instrument for following the rupture of a steel rod is described. D. S.

MECHANICS, QUANTUM.

4459. Quantisation under Two Centres of Force. Part I. Electronic Energies of H_2^+. S. K. Chakravarty. *Phil. Mag.* 28. *pp.* 423–434, *Oct.*, 1939.—In dealing with the problem of the electronic energies of H_2^+, the author considers the most general case of two unequally charged nuclei with one electron in their field, so that the electronic energies of homonuclear as well as of heteronuclear molecules in all their different states can be calculated. The problem is reduced to the form of a determinantal equation, of which first- and second-order approximate solutions are given. The results are applied to the calculation of the $1s\,\sigma$, $2s\,\sigma$ and $3d\,\sigma$ states of H_2^+. The defects in the solutions of this problem by other workers are discussed. G. O. B.

4460. Representation of Lorentz Group and Dirac's Electron Theory. G. Gentile. *N. Cimento*, 16. *pp.* 181–190, *April*, 1939.—The well-known derivation of the spinor representation of the Lorentz group by means of stereographic projection is discussed. R. P.

4461. Spinor Calculus. Part II. T. Sibata. *Hirosima Journ. Sci.* 9. *pp.* 166–193, *Aug.*, 1939. *In English.*—A spinor is expanded in terms of a fundamental set of matrices. Relations between the spinor and the spin-invariant vectors and tensors derived from it can be established by this means. These relations are specialised for the case when the given spinor satisfies a given equation. [For Part I see Abstract 4804 (1938).] G. C. McV.

4462. Spinor Equations for the Meson and Their Solution when no Field is Present. A. H. Taub. *Phys. Rev.* 56. *pp.* 799–810, *Oct.* 15, 1939.—The spinor equations equivalent to the Proca equations for the meson are found. They differ from those proposed by Dirac in three ways: (1) They contain two symmetric spinors A_{1AB}, A_{2AB} and a spinor $B^{A'}{}_{B}$, whereas the Dirac ones contain only one symmetric spinor and the spinor $B^{A'}{}_{B}$. (2) They are invariant under spin transformations corresponding to both proper and improper Lorentz transformations whereas the Dirac ones are invariant under the former alone. (3) When a field is present they contain terms which cannot be obtained from the equations for free particles by replacing the operator p_ν by $p_\nu - e\varphi_\nu/c$ as was proposed by Dirac. In case there is no field present the equations can be solved by introducing two pairs of simple spinors (ψ^A, ϕ^A) and (χ^A, η^A) each of which satisfies a Dirac equation for a free particle of spin one-half. It is proposed to interpret each pair of spinors as representing a free particle of mass m_1 and m_2, respectively. With this interpretation it follows that a free particle of mass m and spin one satisfying the Proca equations is equivalent to a pair of particles of masses m_1 and m_2 satisfying the Dirac equations in the following sense: If the three particles of masses m, m_1 and m_2 are in states determined by the energy momentum vectors p_ν, $p_{1\nu}$, and $p_{2\nu}$, respectively and if $m \neq 0$, then $p_{1\nu} = m_1/m p_\nu$, and $p_{2\nu} = m_2/m p_\nu$, $m = m_1 + m_2$; and the spin of the Proca particle is the vector sum of the spins of the two Dirac particles. AUTHOR.

4463. Undor Calculus and Charge Conjugation. F. J. Belinfante. *Physica*, 6. *pp.* 849–869, *Oct.*, 1939. *In English.*—The term "undor" is used for functions which transform like products of Dirac wave-functions. For each wave function it is possible to find one satisfying the wave equation for the opposite charge, by forming certain linear combinations of the components of the complex-conjugate functions.

Functions which, under this operation, remain unaltered, are described as "neutrettors." No application of this new terminology is given. [See following Abstract.] R. P.

4464. Undor Equation of the Meson Field. F. J. Belinfante. *Physica*, 6. *pp.* 870–886, *Oct.*, 1939. *In English.*—The wave equation of the meson is written in terms of "undors." [See preceding and following Abstracts.] R. P.

4465. Spin of Mesons. F. J. Belinfante. *Physica*, 6. *pp.* 887–898, *Oct.*, 1939. *In English.*—A general expression has been developed for the spin angular momentum and for the moment of a spin momentum density for any arbitrary field. The expressions are applied to the case of a meson field which is defined as an undor field of the second rank satisfying a wave equation. The analysis yields for the total spin momentum the same expression as was obtained elsewhere by Proca. On the other hand the time mean value of the spin does not vanish with quantisation of the field, as has been asserted by Durandin and Erschow. [See preceding Abstract.] G. O. B.

4466. Particle Aspect of Meson Theory. N. Kemmer. *Roy. Soc., Proc.* 173*A*. *pp.* 91–116, *Nov.* 10, 1939.—It is shown that a re-formulation of the meson equations is helpful in the interpretation of the meson as a localised particle. Instead of using the usual tensor form the wave equations are stated as $\partial\beta_\mu\psi/\partial x_\mu + (mc/h)\psi = 0$, where the β_μ are operators completely defined by a set of commutation rules first given by Duffin [*Phys. Rev.* 54. *p.* 1114, *Dec.* 15, 1938]. The theory can be developed in strikingly close correspondence to Dirac's electron theory, practically all the definitions of which find their exact counterpart, *e.g.*, spin, magnetic moment, etc. The algebraic properties of the β_μ are studied in detail, a comparison with other similar formulations is given and the limiting non-relativistic theory is developed. The formalism proves simple to handle and is expected to be useful in all calculations primarily concerned with the particle aspect of the meson. AUTHOR.

4467. Self-Consistent Field with Exchange for Carbon. A. Jucys. *Roy. Soc., Proc.* 173*A*. *pp.* 59–67, *Nov.* 10, 1939.—Solutions of Fock's equations for the self-consistent field with exchange have been carried out for the normal states of C^{+4} and C^{++}, and for all three configurations (^3P, ^1D and ^1S) arising from the normal configuration of neutral C. For neutral C, the energies of the $(2s)$ $(2p)$ shell have been calculated both without and with the inclusion of the term arising from the superposition of the $(2p)^4$ configuration on the normal $(2s)^2$ $(2p)^2$ configuration. Tables of wave functions and energies are given. AUTHOR.

4468. Partition Functions for Partly Classical Systems. E. B. Wilson, Jr. *J. Chem. Phys.* 7. *pp.* 948–950, *Oct.*, 1939.—A method is described for calculating the partition function of systems whose Hamiltonian operator separates into three terms of the following types. The first and second terms are functions of different sets of coordinates while the third is a small coupling term. The energy levels of the first term by itself are widely spaced compared to kT while those of the second are closely spaced. In the result given, the partition function becomes a sum over the widely spaced levels and a phase integral for the contribution of the other levels, as in the case with no coupling term, but here the effect of the coupling term is included in the integral. As an illustration it is shown that the coupling of rotational and vibrational angular momentum in a polyatomic molecule has no appreciable effect on the thermodynamic properties even though it has a marked effect on the energy levels. AUTHOR.

See also Abstracts 4472, 4622.

PHILOSOPHY OF SCIENTIFIC METHOD.

See Abstract 4472.

PRESSURE.

*4469. **High-Pressure Manometer of Free Piston Type. L. Vereschagin and B. Alexandrov.** *J. Techn. Phys. U.S.S.R.* 9. 4. *pp.* 348–351, 1939. *In Russian.*—An improved manometer of the type developed by Bridgeman is described. It works up to 10000 kg./cm^2. and has a linear characteristic. D. S.

*4470. **Electrical Manometer for High Pressure. B. Alexandrov and L. Vereschagin.** *J. Techn. Phys. U.S.S.R.* 9. 9. *pp.* 843–846, 1939. *In Russian.*—The construction of a high pressure manometer based on the change of electrical resistance of a manganin wire is described; the seals of the electrical leads into the high pressure cylinder were tested and found tight up to 10000 kg./cm^2. The details of design necessary to give reproducibility of readings are discussed. [See Abstract 3614 (1935).] D. S.

4471. Distortion of a Curved Tube Due to Internal Pressure. W. R. Dean. *Phil. Mag.* 28. *pp.* 452–464, *Oct.*, 1939.—A method of successive approximation is used to determine the displacement of points on a curved tube, formed by rotating an annulus about an axis so that the centre of the annulus traces out a circle, and subjected to uniform internal hydrostatic pressure. The approximation is carried sufficiently far to determine the part of the displacement that is of most physical interest. The stress corresponding to the part of the displacement is shown to agree, to the correct order of approximation, with the known result. A simple process by which an approximation to the displacement can usually be found fails in the present case owing to a relatively large and approximately inextensional displacement, the effect of which is to make the circular cross-section of the tube oval, the elongation being in the direction of the axis of symmetry of the tube. J. S. G. T.

See also Abstracts 4563, 4614.

RELATIVITY AND ETHER.

4472. Space, Time and Laws of Nature. Y. Mimura and T. Hosokawa. *Hirosima Journ. Sci.* 9. *pp.* 217–225, *Aug.*, 1939. *In English.*—The authors discuss the discrepancies between the concepts of quantum mechanics and the classical mechanics, and the theory of relativity. They show that it is necessary in a theory uniting both aspects of theoretical physics to consider space-time and physical laws simultaneously. They define $ds\psi$ as the metric of the four-dimensional manifold in which physical events occur and demand that only those transformations can be applied which leave $ds\psi = 0$ invariant. By introducing a lower limit of length they establish the quantisation of space-time. L. K.

4473. Cosmology in Terms of Wave Geometry. Part V. Universe with Born-Type Electromagnetism. H. Takeno. *Hirosima Journ. Sci.* 9. *pp.* 195–216, *Aug.*, 1939. *In English.*—In a previous part of this investigation [see Abstract 4805 (1938)] the equation of motion of a particle in curved space containing a field of radiation of Born type, was found. The conditions of integrability of this equation are now worked out in considerable detail. These conditions restrict the metric of curved space to one of five forms. One of these forms is that of the de Sitter universe; another is that of the Einstein universe and the other three are more complicated types. G. C. McV.

See also Abstracts 4461, 4495.

SOLUTION.

4474. $ZnSO_4$ Solutions. Part I. Activity Coefficients in Isodielectric Solvents. Y. Kobayashi. *Hirosima Journ. Sci.* 9. *pp.* 269–298, *Aug.*, 1939. *In German.*—The activity coefficients of $ZnSO_4$ in glycerin-water and methanol-water mixtures have been studied in conjunction with the Debye-Hückel theory of electrolytes. The experimental work is analogous to that of Cowperthwaite and La Mer [see Abstract 2191 (1932)] the activity coefficients of aqueous $ZnSO_4$ solutions being derived from measurements of the e.m.f. of the cells:

$$\text{Zn—Hg}\left|\begin{array}{l}\text{Zn SO}_4\ (m)\\ \text{Glycerin}\ (15\cdot65\%)\text{—H}_2\text{O}\end{array}\right|\text{Pb SO}_4\ (f)\,\big|\,\text{Pb—Hg}\,\big|\ \text{and}$$

$$\text{Zn—Hg}\left|\begin{array}{l}\text{Zn SO}_4\ (m)\\ \text{CH}_3\ \text{OH}\ (10\%)\text{—H}_2\text{O}\end{array}\right|\text{Pb SO}_4\ (f)\,\big|\,\text{Pb—Hg}\,\big|.$$

The amalgams of these electrodes are two-phased and the solvents in both cells at 25° have the same dielectric constant (74·1). A discussion of solvation phenomena of the ions is given based on the activity coefficient data. Very comprehensive experimental details are included in the paper. H. H. Ho.

4475. Non-Aqueous Solutions. C. A. Kraus. *Science.* 90, *pp.* 281–289, *Sept.* 29, 1939.—The influence of the physical properties of the solvent medium upon the properties of solutions is first considered and thereafter the influence of the constitution of electrolytes upon the properties of their solutions. It is pointed out that the properties of solutions of typical strong electrolytes are little influenced by the chemical nature of the medium in which they are dissolved but are chiefly, and very generally, determined by the dielectric constant of the solvent. In a solvent of high dielectric constant, electrolytes are completely dissociated into their ions; and with somewhat lower dielectric constant, short-range ion interaction occurs and an equilibrium exists between simple ions and ion pairs, while in solvents of still lower dielectric constant, ions and ion pairs associate to form triple ions and tend to associate in still greater complexity at higher concentrations leading to very complex relations between concentration and the various physical properties of the solutions. The association of ions to ion pairs depends upon their size, geometrical structure and distribution of charge among the various atoms of the structure. Where interactions other than coulombic occur between the ions or between ions and solvent molecules, the properties of solutions depend upon the nature of the solvent medium. H. H. Ho.

4476. Activity Coefficients of Alkali Halides. R. A. Robinson. *Faraday Soc., Trans.* 35. *pp.* 1217–1220, *Oct.*, 1939.—The isopiestic vapour pressure method has been applied to the determination of the activity coefficients of 41 salts in aqueous solution at 25° with KCl as a reference salt, for which a set of activity coefficients is assumed which agree with the e.m.f. determinations of Harned and Cook and of Shedlovsky and MacInnes. Isopiestic data then give a set of activity coefficients for NaCl, NaBr and KBr which are consistent among themselves as regards both isopiestic and e.m.f. experiments. Finally the author points out that his values for γ_{KCl} are uniformly higher than those previously reported [see Abstract 4449 (1934)]: these are, however, convertible to the new standard by multiplying by the ratio 0·770/0·766; except for the case of cobalt chloride which requires no correction. H. H. Ho.

4477. Relative Osmotic Coefficients of NaCl and KCl in D_2O. R. A. Robinson. *Faraday Soc., Trans.* 35. *pp.* 1220–1222, *Oct.*, 1939.—The substitution of D_2O for ordinary water in a protolytic equilibrium results in a marked effect. A plot of the isopiestic ratios of KCl to NaCl against the molality of NaCl shows that the ratio is considerably higher in D_2O than in water at the same molality, the difference increasing with increasing salt concentration, *e.g.*, at 3*M* NaCl the isopiestic ratio is 1·105 in H_2O and 1·122 in D_2O. This difference is discussed and it is deduced that the ratios of the osmotic coefficients ϕ_{NaCl}/ϕ_{KCl} are almost but not quite the same at corresponding mol. ratios, there being a difference in these osmotic ratios of 0·5 % at the highest concentrations. This preliminary investigation suggests that a determination by an e.m.f. method of the activity coefficient of a suitable salt such as $CdSO_4$ in D_2O would afford a standard from which activity coefficients of a number of univalent salts could be obtained by the isopiestic method, and with density measurements would afford information about the linear term in the extended Debye-Hückel equation. H. H. Ho.

4478. Heat Content and Heat Capacity of NaCl Solutions. R. A. Robinson. *Faraday Soc., Trans.* 35. *pp.* 1222–1228, *Oct.*, 1939.—The isopiestic ratio of NaCl and KCl has been measured over the concentration range 0·1–4 *M* NaCl at 5° intervals between 15° and 60°. For concentrations of 1*M* or less the activity coefficients of NaCl form a link between similar results obtained by Harned and Nims from e.m.f. measurements at lower temperatures and those obtained by Smith from boiling-point measurements at high temperatures. The isopiestic results interpolate very satisfactorily. Over this concentration range a large amount of work is self-consistent, *viz.*, the e.m.f. work of Harned and Nims on NaCl and of Harned and Cook on KCl, the isopiestic data, the boiling-point results of Smith and the partial molal heat contents and heat capacities obtained by Gulbranson and Robinson and by Young and Vogel. For concentrations above 1*M* similar concordance can be obtained provided that it is assumed that the e.m.f. measurements give low activity coefficients of both NaCl and KCl at 45°. The rejection of the e.m.f. data at 40° invalidates previous calculations of thermal data at high concentrations. H. H. Ho.

4479. Activity Coefficients of H_2SO_4 and $LaCl_3$ in Aqueous Solution. R. A. Robinson. *Faraday Soc., Trans.* 35. *pp.* 1229–1233, *Oct.*, 1939.—The activity coefficients of H_2SO_4 and $LaCl_3$ have been reported upon separately since neither can be grouped in any well-defined category of electrolytes. The activity coefficient of H_2SO_4 has been determined by the isopiestic method at 25° between 0·2 and 3*M*; the results were found to be in good accord with e.m.f. and direct vapour pressure determinations and the results quoted may be taken as a good representation not only of the isopiestic results, but also of the other measurements. The activity coefficient of $LaCl_3$ has been ascertained up to 1·5 *M* from a consideration of isopiestic data and the e.m.f. of cells with transport. H. H. Ho.

See also Abstract 4435.

SURFACE PROPERTIES.

4480. Degassing of Hydrogen-Charged Palladium. F. D. Bennett. *Am. Chem. Soc., J.* 61. *pp.* 2683–2686, *Oct.*, 1939.—A stable charge of H_2 in Pd is obtained by the electrolytic method such that the ratio H/Pd is equal to 0·698. This value agrees well with the existing experimental data on the subject. It is shown within the limits of experimental error that all of the important amounts of H_2 in a charged sample of massive Pd are driven off by degassing in vacuum at temperatures as low as 300°. Below this temperature degassing occurs but at much slower rates and with less probability of completion. Further degassing up to the melting point shows negligible liberation of H_2. No correction for unremoved H_2 in the atomic weight of Pd as determined by Gutbier and Kemmerer is indicated. The assumption of Gillespie and Galstaun that their samples of Pd black were sufficiently well degassed by treatment at 650° and over the range 200–300° is correct. AUTHOR.

4481. New Method for Studying Adsorption of Gases at very Low Pressures and Properties of Adsorbed Films of O_2 on W. J. L. Morrison and J. K. Roberts. *Roy. Soc., Proc.* 173*A*. *pp.* 1–13, *Nov.* 10, 1939.—The basis of the method is the fact that the accommodation coefficient of Ne with a W surface is extremely sensitive to the presence of adsorbed films. O_2 contained in a large bulb at a known partial pressure flows first through a long fine capillary tube and then through wider tubes, in which the main resistance to flow arises from the presence of the Ne, to charcoal tubes immersed in liquid air, where it is removed. The wire on which the adsorption takes place is situated in one of these wider tubes and the pressure in its neighbourhood can be calculated accurately from the kinetic theory of gases. The conditions obtaining at the surface of the charcoal have been investigated. Pressures of O_2 from about 2×10^{-9} to about $7{\cdot}5 \times 10^{-6}$ mm. of Hg can be obtained. At room temperature there is a film of O_2 which is stable at the lowest pressures. Above this film is another, the population of which depends on the pressure. The isotherm for this upper film has been determined and it has been shown that the mean life on the surface of a particle in it is not less than about 2 sec. The lower film is itself composite: part of it evaporates at about 1100° K. and the rest not until above 1700° K. The less stable part of this lower film is attributed to molecules adsorbed in the gaps in the immobile more stable part. [See following Abstract.] AUTHORS.

4482. Kinetics of Formation of O_2 Films on W. J. L. Morrison and J. K. Roberts. *Roy. Soc., Proc.* 173*A*. *pp.* 13–27, *Nov.* 10, 1939.—The method described [see preceding Abstract] has been applied to the study of the kinetics of the formation of O_2 films. If θ is the fraction of the sites on the surface which is occupied by adsorbed O_2 at time t, it has been shown that at constant pressure the variation of $d\theta/dt$ with θ is what would be expected for the system to which O_2 has been shown to belong in the preceding paper, *i.e.*, a stable film with a less stable and presumably mobile film above it. The fact that the particles in this upper layer can migrate and thus have an increased opportunity of finding a suitable vacant place where they can be adsorbed into the stable film affects markedly this relation between $d\theta/dt$ and θ. The relation between the accommodation coefficient a and θ is also discussed. AUTHORS.

4483. Adsorption of Phosphate Ion by Enamel, Dentine and Bone. M. LeF. Manley and S. R. Levy. *Am. Chem. Soc., J.* 61. *pp.* 2588–2590, *Oct.*, 1939.—Quantitative measurements on the adsorption of phosphate ion by powdered enamel, dentine and bone have been made. From varying concentrations of radioactive phosphorus as sodium acid phosphate in ethylene glycol, the tissues adsorb phosphate according to the Freundlich adsorption isotherm. The adsorptive power of dentine and bone are about the same and seven times greater than that of enamel.

AUTHORS.

4484. Lateral Cohesion in Protein Monolayers. L. Fourt. *J. Phys. Chem.* 43. *pp.* 887–899, *Oct.*, 1939.—The surface viscosity of unimolecular layers of proteins and other substances has been determined, subject to the fulfilment of certain conditions, from the damping of a vane oscillating in the film. This method is particularly useful in working with substances like proteins which form rigid films. A quantitative index of surface elasticity is obtained from the shortening of the period of the oscillating vane. This effect is not due merely to the sweeping action of the vane but is related to the intrinsic elastic properties of the film materials. Expressions relating the surface viscosity and elasticity to the length of the vane are given. The pH of the subsolution is found to be an important factor in determining the viscosity and elasticity of a protein film. The pH dependence of rapid bond formation within the film suggests that these links are ionic. Quantitative spreading into the unimolecular film is observed when the processes which bring about distribution of the film substance precede or overbalance the restraining tendencies of rapid bond formation.

AUTHOR.

4485. Changes of Phase and Transformations of Higher Order in Monolayers. D. G. Dervichian. *J. Chem. Phys.* 7. *pp.* 931–948, *Oct.*, 1939.—The gaseous, liquid, mesomorphous and solid states in monolayers are defined and their close connection with the corresponding states in three dimensions rigorously established. This involves a new treatment of the two-dimensional liquid and of its transformation to the mesomorphous state. The properties of the three-dimensional vitreous state of fatty substances are shown to be particularly important in connection with the behaviour of monolayers. The different critical and transformation temperatures are also defined and their significance explained. From this is derived a systematic classification of the different types of isotherms observed. By determining the variations of the compressibility, viscosity and apparent dipole moment with change of area, higher order transformations are detected in monolayers. These transformations occur at the same areas as those at which ordinary phase transformations occur at lower temperatures.

AUTHOR.

4486. Electrical Double Layer at Interface of Two Liquids. E. J. W. Verwey and K. F. Niessen. *Phil. Mag.* 28. *pp.* 435–446, *Oct.*, 1939.—Theoretical. The potential function at the interface of two liquid phases between which a small amount of electrolyte is distributed is considered. The general potential curve is derived. The total potential drop is divided into two parts one pertaining to each side of the interface, the size of which is given by $\alpha = (n_2K_2/n_1K_1)^{\frac{1}{2}}$, where n = ionic concentrations and K_1 and K_2 are dielectric constants, and by the Boltzmann equation. The largest part of the potential drop occurs in the phase where the product nK has the smallest value.

A. J. M.

4487. Specific Surface of Fibrous Materials. E. J. Wiggins, W. B. Campbell and O. Maass. *Canad. J. of Research,* 17. *Sect. B. pp.* 318–324, *Oct.*, 1939.—The Kozeny equation relating specific surface and permeability of a bed of unconsolidated particles has been shown to be applicable to fibrous materials such as glass, wool and celanese. The diameters of the constituent fibre may be as small as 0·0006 cm., while their ratio of length of diameter may be indefinitely large. Uniformity of size or of packing is not essential. AUTHORS.

See also Abstracts 4433, 4568, 4569, 4661, and
2475B. Effect of Pressure on Viscosity in Relation to Lubrication. J. W. Givens.
2480B. Relations between Crystal Structure and Corrosion. G. Derge.

TIME.

See Abstract 4687.

VISCOSITY AND FRICTION.

***4488. Modified Method of Using Poiseuille's Apparatus. J. Bhimasenachar.** *Indian Acad. Sci., Proc.* 10*A. pp.* 141–144, *Sept.*, 1939.—A modified method of using Poiseuille's apparatus for measuring the viscosities of highly viscous liquids at different temperatures is described. Glycerin is chosen as a typical example for study and the viscosities obtained with this liquid at different temperatures are given. AUTHOR.

***4489. Viscosity of Liquids at High Hydrostatic Pressures. R. B. Dow.** *Phil. Mag.* 28. *pp.* 403–422, *Oct.*, 1939.—The construction of a concentric cylinder viscometer for high pressures is described. The results of various workers with the different absolute and relative methods of high pressure viscometry are reviewed. The viscosity of CS_2–CCl_4 mixtures has been determined at pressures up to 10000 kg./cm^2., and at 30° and 75°. The mixture was chosen to consist of non-polar liquids whose force-fields are quite different. The coefficient of viscosity is not a simple function of the composition of the mixture. The variation of the coefficent with temperature at various pressures is expressed as the ratio of the coefficient at 30° to that at 75°. Initially this ratio decreases with increase of pressure for both components and mixtures, and reaches a minimum at approximately 1500 kg./cm^2. for almost all the mixtures. Some theoretical aspects of high pressure viscometry are discussed. A. J. M.

4490. Influence of Electric Fields on Flow of p-Azoxyanisole in Capillary Tubes. G. Mikhailov and V. Zvetkov. *J. of Exp. and Theor. Phys. U.S.S.R.* 9. 2. *pp.* 208–214, 1939. *In Russian.*—Using the capillary method it was found that a longitudinal electric field reduces and a transverse field increases the time of flow of p-azoxyanisole. The effects disappear in the isotropic phase. The transverse increase occurs only if the speed of flow is not high enough to have a large orienting effect, and disappears also with increase of frequency. The authors interpret the results as being due not to a direct orienting effect of the field, but to a flow in the anisotropic liquid caused by the field. [See Abstract 1880 (1938).] D. S.

4491. Friction in a Vacuum. V. Rakov and R. Sokolova. *J. Techn. Phys. U.S.S.R.* 9. 9. *pp.* 786–789, 1939.—The effect on the friction between various materials of reducing the air pressure was investigated, and it was found that the coefficient of friction first fell slightly but finally, in a vacuum, increased above its original value. The effect of heating the rubbing surfaces was also examined. D. S.

See also Abstract 4455.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

See Abstracts 4499, 4500.

COMETS AND METEORS.

4492. Origin of Meteors. C. C. Wylie. *Science*, 90. *pp*. 264–265, *Sept*. 22, 1939.—The orbits of six bright meteors were calculated and compared with those of the nearest asteroids and comets, showing them to agree much more closely with those of the asteroids, the periods of both meteors and asteroids being of the order of two years, and negativing the suggestion that meteors come from the fixed stars, for which the period would be some millions of years. C. A. S.

4493. Determination of Meteor Velocity from Zenith Attraction. H. Inouye. *Roy. Astron. Soc., M.N.* 99. *pp*. 738–741, *Oct*., 1939.—A method is suggested for the determination of meteor velocities from observations made at one station only. A table for the application of the method is given, and an example of the calculation of the velocity of the Leonids is included. The limitations of the accuracy of the method are investigated. AUTHOR.

4494. X-Ray Study of Meteoric Irons. E. A. Owen and B. D. Burns. *Phil. Mag.* 28. *pp*. 497–519, *Nov*., 1939.—Fragments from 24 meteoric irons containing from 4·39 to 25·6% Ni with small amounts (total ≯ 1·65 %) of Cu, Cr, P, S and/or C were examined by X-rays, as collected, after annealing for 5 or 8 weeks at 350° and rapid cooling, or in some cases also at 400° and 500°. Meteorites containing ≯ 6·2 % Ni after annealing showed only the parameter of the α phase (kamacite), those with more Ni both the α and γ (taenite) phase parameters. The α parameter increases with Ni until the latter is 6·2 % and then becomes constant. Results imply that the composition of kamacite is constant, whether occurring alone or as a constituent of plessite. The γ parameter showed greater variation, possibly on account of the material having at some stage cooled too rapidly to attain equilibrium. Generally results show that meteoric irons closely resemble artificially prepared Fe-Ni alloys in their reactions to different heat treatments. C. A. S.

COSMOGONY.

4495. Proper Variations of the Expanding Universe. E. Schrödinger. *Physica*, 6. *pp*. 899–912, *Oct*., 1939. *In English*.—The second-order wave-equation of flat space is generalised to curved space by writing down the corresponding tensor equation. This equation can be used for light or for particles by adjustment of a constant. The generalised equation is then solved for the case of the expanding universes of general relativity. Proper vibrations can be found but these are relative to the coordinate system which the investigator happens to employ. In terms of the usual "co-moving" coordinates it is shown that proper vibrations of opposite sign are not, as in flat space, independent of each other. Physically this would mean that light could be self-reflected with the passage of time and that particles might be annihilated. This situation does not arise if the radius of space increases as a linear function of cosmic

time. The author does not discuss the possibility that his generalised wave-equation may not, in fact, be the correct form for curved space.
G. C. McV.

See also Abstracts 4473, 4670.

LATITUDE AND LONGITUDE.

4496. Law of Error in Greenwich Variation of Latitude Observations. H. Jeffreys. *Roy. Astron. Soc., M.N.* 99. *pp.* 703–709, *Oct.*, 1939.—The two series of residuals of the Greenwich variation of latitude observations agree with laws of Pearson's Type VII with indices of about 2·7 and 2·2. This is a very large departure from the normal law of error, but has probably been increased by variation of the observing conditions. Comparison with the data given by Pearson suggests that the index for homogeneous observations is likely to be between 3 and 5, and that there would be advantages in using a law with index 4 in the reduction of observations. AUTHOR.

PLANETS.

4497. Markings of Jupiter's Satellites in Transit. E. M. Antoniadi. *Roy. Astron. Soc. Canada, J.* 33. *pp.* 273–282, *Sept.*, 1939.—The author urges the use of large telescopes as their powerful light grasp is decisive, especially for planetary colours. For satellite I, he gives albedo 0·53 as against Jupiter's 0·50; II has the highest albedo in the solar system except for Saturn's rings; IV has albedo lower than Mars, but higher than Mercury or the Moon. The colours and shades of I, II and III are described; also the colours of their shadows. IV has very conflicting estimates of its colours; in transit it is sometimes completely black, but not always. The author finds that all four satellites turn the same face to Jupiter. All have also diminishing brightness with phase, indicating a rough surface like the Moon's. I and II are probably masses of rock. As solar radiation is 27 times feebler than on Earth for Jupiter's satellites, their gaseous molecules are slowed down, and they may have a rare atmosphere of heavy gases. A. S. D. M.

4498. Colours on Jupiter. W. H. Haas. *Roy. Astron. Soc. Canada, J.* 33. *pp.* 283–286, *Sept.*, 1939.—The author has carried out a systematic programme of visual observations of colour on Jupiter. The primary difficulty is the absence, here, of any area of standard colour, and the programme must be carried on with one telescope and constant magnification, and all conditions must be similar and stable. He gives the number of observations and the times for each of the observers, and describes the methods. A by-product of these observations is the evidence of differences in the colour sensitivity of different eyes. He urges monochromatic photography for the Jovian colours. He contends that on Jupiter the coloration must be due to selective absorption by gases, but as yet no explanation can be given as to how the mechanism acts. A. S. D. M.

STARS.

***4499. Modification of Michelson Interferometer Method for Determination of Stellar Diameters. P. Lacroute.** *Roy. Astron. Soc., M.N.* 99. *pp.* 733–734, *Oct.*, 1939.—It is pointed out that if a fringe system could be formed having the stationary properties claimed by Fürth, Sitte and Appel [see Abstract 1540 (1939)] they would be useless for determining stellar diameters. Such fringes are not produced by their arrangement. Possible explanations of their seeming experimental success are suggested. [See following Abstract.] AUTHOR.

***4500. Proposed Modification of Michelson's Stellar Interferometer. J. A. Carroll.** *Roy. Astron. Soc., M.N.* 99. *pp.* 735–737, *Oct.,* 1939.—Examination of the diffraction and interference problems involved in the modification of Michelson's method proposed by Fürth, Sitte and Appel [see Abstract 1540 (1939)] shows that stationary fringes cannot be formed in the manner suggested. Experimental test shows that the fringes formed by the proposed arrangement are affected by disturbances in just the same way as are Michelson's. [See preceding Abstract.] AUTHOR.

4501. Surface Temperatures of Stars. W. M. H. Greaves. *Observatory,* 62. *pp.* 252–273, *Oct.,* 1939.—The breakdown of the Fowler-Milne scale of stellar temperatures is traced to the assumption that the atomic absorption coefficients are independent of frequency and the consequent deduction that stars radiate approximately as black bodies. Calculations of the increase of the hydrogen absorption coefficient with wave-length give for A0 stars (in whose spectra H is predominant) colour temperatures higher than the effective temperatures, these latter being in agreement with the Fowler-Milne scale. With advancing spectral type the absorption coefficient begins to vary with wave-length in the opposite sense, due to the increasing importance of metallic atoms, a balance being reached at solar temperatures. Imperfections of our present mathematical technique, and lack of knowledge of metallic absorption coefficients, stand in the way of building a theory which will predict the variation of colour temperature with wave-length and the discontinuities at series limits. A new theory should also predict the centre-limb contrast in the sun and in eclipsing binaries, and should not neglect the possibility of convective energy transfer, of breakdown of the hypothesis of local thermodynamical equilibrium, and of an appreciable contribution by negative H ions to the total absorption coefficient. A. HU.

4502. Equations of Radiative Equilibrium and Transport of Energy. G. Tiercy. *Arch. des Sciences,* 33. *pp.* 133–165, *May–June, and pp.* 169–186, *July–Aug.,* 1939.—In problems of the radiative equilibrium of grey matter it is usually assumed that the energy of black radiation B, is a linear function of the optical depth. The author considers a more general type of solution by dividing the star into three regions, *viz.* (1) an inner region where the energy generation is non-zero; (2) an outer layer in which energy generation is zero and B is a linear function of optical depth; (3) an outermost layer where energy generation is still zero but B involves a logarithmic, as well as a linear, term in the optical depth. Full details of the solution are given and it is shown that a stellar model of this type is possible. G. C. McV.

4503. Nuclear Reactions in Stellar Evolution. G. Gamow. *Nature,* 144. *pp.* 575–577, *Sept.* 30, *and pp.* 620–622, *Oct.* 7, 1939.—A table is given showing the energy production per reaction of all possible thermonuclear reactions between protons and nuclei of elements up to atomic number 11. The energy production per gm. per sec. is then calculated for the conditions holding in the solar interior and compared with observation. Most of the reactions can thus be eliminated as sources of solar radiation, and it is deduced that energy production in the sun is due to C–N reaction cycles in which ^{12}C and ^{14}N nuclei act as catalysts to the transmutation of H into He. The same mechanism, allowing for different stellar masses, suffices for main-sequence stars. The author sketches the evolutionary changes of a star due to the continuous consumption of H by the energy-producing reaction. Other reactions are invoked to explain giant and variable stars: the main transformations are of ^{10}B in cluster variables; of ^{6}Li, ^{7}Li, ^{9}Be, and ^{11}B in Cepheids; and of ^{2}H and possibly ^{3}H in long-period variables. These nuclei are not regenerated, so that as soon as one element is consumed, the star contracts gravitationally until its central temperature rises sufficiently to start the next reaction. The final evolutionary stage of a star which has used all its store of H depends on the mass: a light star will tend to electron degeneracy and will become a white dwarf; a heavy star will eventually collapse on to a neutron core, with the liberation of an enormous amount of gravitational energy. The author concludes that the problem of stellar evolution and energy sources is practically solved. A. Hu.

4504. Stellar Structure and Stellar Energy. W. H. McCrea. *Roy. Astron. Soc., Occasional Notes, No.* 6. *pp.* 78–88, *Oct.*, 1939.—The present position seems to be that the following features are fairly securely established. The energy-generation in at any rate brighter stars of the main sequence is provided by the formation of He from H_2. These stars have a large H_2 content, and their central temperatures are all in the neighbourhood of 20 million degrees. There is no evidence for the synthesis of heavier nuclei in stars, but some of these nuclei have an essential rôle as catalysts in the synthesis of He. The not too massive stars of the main sequence ultimately contract and become white dwarfs. The giants differ essentially from main-sequence stars in their structure or mode of energy-generation, or both. Amongst unsolved problems are those of the ultimate fate of massive stars, the mechanism of energy production in giants, and, most fundamental of all, the origin of heavier nuclei in stellar material in general. A notable advance would have been made if it could be asserted that nuclear transmutation is the normal source of stellar luminosity, *i.e.*, that this phenomenon produces the bulk of the energy radiated by a typical star during its lifetime. All that can actually be said is that the weight of the evidence seems at the moment to favour this conclusion. Author.

4505. Galactic Density Gradients. B. J. Bok. *Astrophys. J.* 90. *pp.* 249–270, *Sept.*, 1939.—An attempt is made to investigate the gradients of the star density in the galactic plane for two sections of the Milky Way, in Monoceros and in Cepheus-Cassiopeia respectively. A study is first made of the change of colour excess with distance for successive intervals of spectral type, and total photographic absorptions are then derived from the reddenings by the use of appropriate factors. Star counts to faint magnitude limits, and statistics of the distribution of spectral types then provide data from which the change of star density with increasing distance from the sun can be determined. For distances from the sun up to 1200 psc. in the direction of Monoceros, considerable negative density gradients exist in the galactic plane for B8–A5 stars, though for other types the star density remains fairly constant. In Cepheus-Cassiopeia, a region much less free from local obscuration, the star density for all types drops gradually up to 2000 psc. from the sun. A. Hu.

4506. Ursa Major Cluster (Second Paper). W. M. Smart. *Roy. Astron. Soc., M.N.* 99. *pp.* 710–722, *Oct.*, 1939.—A list of 101 stars regarded as members of the Ursa Major Cluster by Nassau and Henyey is further investigated according to criteria depending on position angle of proper motion, radial velocity, parallax and absolute magnitude. Including Gr. 1970 (additional to the list referred to), 19 stars are believed to belong to the cluster, while 47 are possible members. The remaining stars (36 in number), it is concluded, are not cluster stars. The total membership of the cluster is 42. Of these, 23 are dealt with in a previous paper [see Abstract 2423 (1939)]. Ten stars are within five parsecs of the centre of the cluster. The greatest diameter of the cluster is found to be about 150 parsecs. Of the cluster stars 36 belong to the main series in the Hertzsprung-Russell diagram, while 3 are G5 and 3 are K0 giants. AUTHOR.

4507. Micrometrical Measures of Double Stars. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 99. *pp.* 741–746, *Oct.,* 1939.

See also Abstracts 4580, 4603.

SUN.

4508. Curious Phenomenon in a Partial Solar Eclipse. M. Pierucci. *N. Cimento,* 16. *pp.* 225–228, *May,* 1939.—The author observed during the partial solar eclipse of 1936, June 19, an enormous increase in atmospheric conductivity recorded by the electroscope. He observed the phenomenon again in the eclipse of 1939, April 19. The effect was less, the second eclipse being much smaller than the first. A graph is given showing the effect correlated with the phases. In both cases the sun was low on the horizon, rising in the first and setting in the second. The author asks for similar observations to collect more data. E. M. W.

4509. Influence of Variability of Mean Latitude of Sunspots on Recurrence Tendency of Magnetic Disturbances. G. H. Archenhold. *Roy. Astron. Soc., M.N.* 99. *pp.* 721–729, *Oct.,* 1939.—It is pointed out that the recurrence interval of terrestrial magnetic disturbances is definitely smaller in years preceding a sunspot minimum than in years following a minimum. The difference between each three years before and after a minimum is found to be 0·5 day with a mean error of ± 0·14 day. The recurrence interval shortens continually from the beginning of the cycle to the end as is to be expected from the decline of the mean equator distance of the sunspots. In years with sunspot zones, both near the equator and in higher latitudes, the shorter recurrence interval of the equator belt prevails, because disturbed areas of the sun's surface are the more effective on the earth's magnetism the smaller their mean distance from the equator. AUTHOR.

4510. Broadening of Fraunhofer Lines by Turbulence. P. ten Bruggencate. *Zeits. f. Astrophysik,* 18. 4–5. *pp.* 316–329, 1939.—It is shown that the observed width of faint photosphere lines (*i.e.*, comparatively faint Fraunhofer lines from an undisturbed part of the solar surface near the centre of the disc) can only be reconciled with the observed width of sunspot lines and the observed line contour conditioned by the spectrograph by assuming occurrence of turbulence. The mean velocity of turbulence is found to be 1·8 km./sec. The calculated profile of a faint Fraunhofer line is compared with the observed profile of Fe $\lambda 5229\cdot 86$ (Rowland intensity 4). The number of atoms effective in producing a line of Rowland intensity 4 is estimated as $NHf = 1\cdot 3 \times 10^{13}$. J. E. K.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE

4511. He-Ne Content of Sea Water and its Relations to the O_2 Content. N. W. Rakestraw, C. E. Herrick, Jr. and W. D. Urry. *Am. Chem. Soc., J.* 61. *pp.* 2806–2807, *Oct.*, 1939.—A repetition of earlier work [see Abstract 2465 (1935)] under more suitable and representative conditions, shows the sea to be practically saturated with He and Ne at all depths, with no evidence of any depth of minimum concentration, and hence no relation to the depth of oxygen minimum. AUTHORS.

4512. Ra Content of an Ocean-Bottom Core. C. S. Piggot and W. D. Urry. *Washington Acad. Sci., J.* 29. *pp.* 405–409, *Oct.* 15, 1939.—The development of the new ocean-bottom sampler has made available a number of cores, one of the objects of the apparatus being to probe below the ocean-bottom surface and to determine the radioactive relationship between the ocean troughs and the continents. One of the Atlantic cores is extremely uniform in composition both chemically and lithologically and was chosen as the most suitable core to examine preliminarily in order to ascertain, if possible, the radioactive equilibrium relations before proceeding to the more complex cores exhibiting wider variations in composition. Determination of the Ra content at various depths in the core shows: (A) no decrease in the Ra content with depth; (B) a Ra content corresponding approximately to that of the granites. The conclusions based on this exploratory investigation, which must be limited to this particular core, are: (1) that, with regard to the length of time here represented, the presence or absence of U has no bearing on the Ra content; (2) that the ionium is probably present in an amount corresponding roughly to radioactive equilibrium with the Ra; and (3) that in view of the widely differential chemical properties of ionium (Th) and Ra, chemical deposition plays no rôle in the radioactivity of this particular core. This does not exclude the possibility that chemical deposition may be important in other instances. AUTHORS.

See also Abstract 4519.

LAND, PHYSICS OF THE.

***4513. Dilatometer for Bound Water in Soils and other Colloidally Dispersed Materials. T. F. Buehrer and M. S. Rosenblum.** *J. Phys. Chem.* 43. *pp.* 941–951, *Oct.*, 1939.—A new dilatometer has been perfected which makes possible a precise control of experimental conditions. The effect of changes in the temperature of the freezing bath and the capillary have been investigated, and a quantitative expression for the correction to be applied to the observed data has been presented. It is shown that when conditions are so controlled and the proper corrections are applied to the measurements, the results obtained by any one observer are reproducible within 1 to 2%. AUTHORS.

See also Abstract 4450, and
2529B. H.F. Characteristics of Rocks. M. Kadowaki.

METEOROLOGY.

4514. Atmospheric Ozone at Bombay. M. W. Chiplonkar. *Indian Acad. Sci., Proc.* 10*A*. *pp.* 105–120, *Sept.*, 1939.—The paper describes the daily measurements of atmospheric ozone made at the Colaba Observatory, Bombay, during the period Oct. 1936 to Sept. 1938 with a Dobson's spectrograph by the method of photographic photometry. The average amount of ozone and its seasonal variation found at Bombay are in general agreement with those to be expected from Dobson's world-wide ozone survey in 1930. The annual variation is however disturbed by some unknown factor which makes the values on some of the days in the monsoon unusually low, giving rise to a hump in the seasonal variation curve in the months Sept.-Oct. A similar disturbing influence is also to be noted from the earlier measurements at Zikawei, Helwan and Kodaikanal, at about the same period of the year. There is practically no correlation between the daily value of ozone, and the pressure at ground level.

AUTHOR.

4515. U.V. Energy in Daylight. M. Luckiesh, A. H. Taylor and G. P. Kerr. *Frank. Inst., J.* 228. *pp.* 425–431, *Oct.*, 1939.—The results of a 4 years study of u.v. energy in daylight are summarised. The observations were made in Cleveland, and energy was measured by a photo-cell sensitive to energy shorter than 3350 Å. The type of cell used responds to u.v. energy of various wave-lengths approximately in accordance with their effectiveness in producing sunburn. The average monthly variations of u.v. energy in daylight incident on a horizontal plane for the 4-year period are shown by diagram and set out in a table. The effect of cloudiness is considered. As the u.v. energy falling on a horizontal plane comes from both sun and sky the ratio of these quantities for a number of clear days has been determined and is shown graphically. In the summer months the amounts are nearly equal and this explains why sunburning arises from exposure to the sky only. Among other results arrived at by the investigation it is found that the u.v. energy in June is approximately 9 times that in January and 17 times that in December.

A. E. M. G.

4516. Conservatism of Equivalent Potential and Wet-Bulb Potential Temperatures. W. Bleeker. *Roy. Meteorolog. Soc., J.* 63. *pp.* 542–550, *Oct.*, 1939.—It is possible to define two " equivalent " temperatures; one by consideration of an isobaric process, called isobaric equivalent temperature (T_i''), and one by consideration of dry and saturated adiabatic processes, called adiabatic equivalent temperature (T_a''). The difference ($T_a'' - T_i''$) equals the caloric value of an area in a thermodynamic diagram. In the same manner one can define two " wet-bulb " temperatures; one by consideration of an isobaric process, called isobaric wet-bulb temperature (T_i''), and one by consideration of dry and saturated adiabatic processes, called adiabatic wet-bulb temperature (T_a'). The conservatism of the different equivalent and wet-bulb temperatures and their potential values is discussed and it is shown that there exists no single equivalent and wet-bulb temperature which is conservative for all three processes: (1) dry-adiabatic changes, (2) saturated-adiabatic changes, and (3) evaporation of rain falling through the air. This leads to the conclusion that the so-called wet-bulb potential temperature should be carefully handled for identification of moving air masses [see Abstract 3562 (1936)]. The use of the wet-bulb potential temperature may give a wrong impression of the gain of water by evaporation, and may lead to erroneous results in estimations of vertical displacements in cases where evaporation occurs.

AUTHOR.

4517. Development and Occlusion of Warm Sectors. C. K. M. Douglas. *Roy. Meteorolog. Soc., J.* 65. *pp.* 525–532, *Oct.,* 1939.—The initial formation of a warm sector is attributed mainly to geostrophic motion, associated firstly with external systems and secondly with deformation of the warm air mass. The occlusion process is due to a combination of convergence with a suitable distribution of geostrophic motion. The concentration of convergence ahead of the warm front is attributed mainly to the isallobaric effect and not to curvature. AUTHOR.

4518. Constancy of Horizontal Turbulent Shearing Stress in Lower Layers of Atmosphere. K. L. Calder. *Roy. Meteorolog. Soc., J.* 65. *pp.* 537–541, *Oct.*, 1939.—It may readily be shown, from elementary arguments, that for steady fluid flow in circular tubes or between parallel plates, the shear stress in the direction of the mean motion varies linearly with the distance from the wall. This result is quite independent of the nature and origin of the fluid resistance and in particular is valid if the flow be turbulent. However, it has been proved by Ertel (1933) that in the lower layers of the atmosphere ($1 \leq z \leq 30\,m$) the horizontal turbulent shearing stress defined by $\tau = \eta\ (z)\ \partial v/\partial z$ where $\eta\ (z)$ is the vertical *austausch* coefficient and $\partial v/\partial z$ the vertical gradient of mean velocity, is to a high degree of approximation independent of the height. In view of the importance of this conclusion in atmospheric turbulence theory, and its obvious difference from the first, it has been thought worth while to examine Ertel's treatment in detail. The latter is based on the assumption of the isotropy of the coefficient of vertical turbulent momentum interchange and the final result depends on the relative smallness of the variation of wind direction with height in the surface layers. Complete neglect of this variation, however, requires a wind velocity constant with height, in which case Ertel's result would become trivial. The object of the present note is to show that the assumption of very small but plausible values for the wind direction change with height in the surface layers (of order 10^{-6} radians/cm.) suffices to account for the observed wind velocity increase in the lower layers. It may be concluded that Ertel's analysis is sound. Furthermore it appears on the basis of the theory that the mean wind direction change with height in the lower layers is too small to be observed practically. AUTHOR.

4519. Wind and Sea Disturbance in the Hebrides. D. L. Champion. *Roy. Meteorolog. Soc., J.* 65. *pp.* 511–517, *Oct.,* 1939.—In this note an attempt is made to ascertain the effect of exposure on the disturbance of Hebridean seas, as produced by winds from different directions and of various forces on the Beaufort scale. The term "sea disturbance" is taken in its broadest sense, being the actual state of the surface of the sea as experienced by the observing ships at the time of observation, whether the roughness be due to wind-waves or swell or a combination of both these elements. The height of waves is the apparent distance in feet from trough to crest, as estimated by eye observation by the masters of the observing ships. A comparison is made between the relative roughness of the Minch and the Sea of the Hebrides; and the apparent effect of the width of the channel, at right angles to the wind, on the height of waves up channel from seaward is shown from data obtained in the Sound of Sleat. AUTHOR.

4520. Cyclonic and Anticyclonic Development. R. C. Sutcliffe. *Roy. Meteorolog. Soc., J.* 65. *pp.* 518–524, *Oct.,* 1939.—Development of pressure systems involves horizontal divergence (positive or negative) approximately balanced by divergence of opposite sign in the upper troposphere, the total divergence integrated vertically and represented by the rate of change of surface pressure being a relatively small residual. It follows that a criterion for development is that there should be a significant difference between the lower and upper fields of divergence. Divergence is determined by the field of geostrophic departure or acceleration and it is shown that the difference between lower and upper divergence consists of two parts due respectively to shearing and to the development of thermal gradients. Rules concerning the distribution of surface divergence and convergence in different pressure and temperature distributions are inferred and a method of approaching the problem of forecasting on a three-dimensional basis is put forward. AUTHOR.

4521. Analysis of Precipitation Measurements on Mountain Watersheds. H. G. Wilm, A. Z. Nelson and H. C. Storey. *Monthly Weather Rev.* 67. *pp.* 163–172, *June*, 1939.—The analysis had as its object to determine the reliability of computed rainfall averages and to decide on any modifications of or additions to the original rain-gauge distributions necessary to obtain results accurate within pre-established limits. Precise data were obtained for two sets of three small watersheds and averages found for ten intermediate watersheds of varying size and complexity on the south slopes of the San Gabriel mountains, Los Angeles. With the mechanical distribution of gauges described a reasonably thorough sampling of rainfall variation is obtained and can be improved by a study of isohyetal maps and statistical constants based upon a preliminary rain gauge installation. The results obtained for most storms are accurate within practical limits. The requirements for accuracy of averages should be modified inversely to the size and importance of the storms. When gauges are distributed to sample thoroughly rainfall variation, a simple average of their readings agrees closely with the rainfall catch computed from isohyetal maps and this method requires much less time and skill. R. S. R.

4522. Correlations Between Monthly Rainfall at Eleven Stations in the British Isles. D. A. Boyd. *Roy. Meteorolog. Soc., Mem.* 4. *pp.* 143–157; *Disc.*, 157–160, *Sept.*, 1939.—The paper is based upon rainfall records for the months of Jan., April, July and Oct. at 11 stations in the British Isles over the period 1870–1929. The means, variances and covariances were computed. Percentage standard deviations were obtained and mapped, the general distribution proving fairly similar in all months. A correlation coefficient for each pair of stations in each of the chosen months was evaluated, and transformed to Fisher's z. The value of z was dependent to a considerable extent on the inter-station distance and bearing. The linear regression of z on distance between stations was significant in each month, but the quadratic term was small and non-significant. The remaining two terms of the regression, associated with the bearing between pairs of stations, reached significance on only two occasions out of the possible eight; but, as a whole, they gave a reasonably coherent picture of monthly changes in the inter-station bearing at which correlation reached a maximum. To account for such changes, and for changes in z, data given by other workers were examined. The variations appeared to be closely associated with the persistence of a pressure gradient for winds from the south-westerly quadrant. A large part of the residual variance is shown to be due to a marked regional variation, the association between monthly rainfalls being greatest in the south and least in the north.

Maps of the residual z's show that the association within groups of stations on the west coast or on the east coast was greater than that between the west and east coast groups. AUTHOR.

4523. Analysis of Indian Rainfalls Using the Median as a Statistic. L. S. Mahalingam. *India Meterolog. Dept., Sci. Notes,* 7. 82. *pp.* 243–254, 1939.—A general test, called the स test, which was recently suggested by S. R. Savur [see Abstract 3399 (1937)] has been used in this paper to analyse the monthly rainfall data at 35 representative stations in India. The analysis, which is based on the 5% limits for random chance for स, reveals the following points :—(i) The rainfall associated with thunderstorms in the hot weather months is sharply differentiated from the rainfall of the monsoon months. (ii) During the monsoon months a significant increase in rainfall amount is found from June to July, except in Burma and parts of north-east India. July, which has generally the highest rainfall, is found to show no significant difference from August, except in the western parts of the Peninsula. September shows generally a distinct decrease from August, except in the southern and eastern parts of the Peninsula. AUTHOR.

***4524. Thermoelectric Anemometer for Low Flow Velocities. K. Wassiliew.** *J. Techn. Phys. U.S.S.R.* 9. 8. *pp.* 724–729, 1939. *In Russian.* —The performance is discussed of an anemometer in which the air flow changes the temperature of an electrically heated wire, the temperature being measured with a thermocouple. The anemometer is suitable for flow velocities up to a few hundred cm./sec. and its calibration does not change appreciably over a period of several months. D. S.

4525. Meteorological Results of the Byrd Antarctic Expeditions, 1928–30, 1933–35 : Tables. G. Grimminger and W. C. Haines. *Monthly Weather Rev., Suppt. No.* 41. [377 *pp.*], *Oct.*, 1939.

***4526. Atmospheric Contamination. A. H. Pfund.** *Science,* 90. *pp.* 326–327, *Oct.* 6, 1939.—Physical methods for evaluating the concentrations in air of CO_2, CO, CH_4, etc., which have strong absorption bands in the infra-red are discussed. The first apparatus used in the determination of the concentration of CO_2 is described and illustrated. Certain defects in the method having become evident a second improved procedure was evolved. This is fully described. From observations made it is concluded that if radiations from a jet of hot gas X fall on a receiver filled with X, the presence of X between source and receiver will be definitely recognised. A. E. M. G.

SEISMOLOGY.

4527. Graphic Methods for Determining Epicentric Conditions of Near Earthquakes. P. Caloi. *Ricerca Scientifica,* 10. *pp.* 645–663, *July–Aug.*, 1939.—Two simple geometrical methods for finding epicentric coordinates and hypocentric depth of a near earthquake are described. The methods, although rapid, do not sacrifice precision, as is shown by worked examples. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

***4528. Atmospheric Recorder. I. Ranzi.** *Ricerca Scientifica,* 10. *pp.* 664–674, *July–Aug.*, 1939.—A new apparatus for recording atmospherics is described. Besides incorporating special receivers for the particular study of impulses, the instrument has an electrodynamic oscillograph which operates a writing pen. W. A. R.

4529. Atmospheric Electric Field in the Atlantic and Pacific Oceans. J. Rouch. *Comptes Rendus*, 209. *pp.* 564–565, *Oct.* 9, 1939.—Observations were made with an Al-leaf electroscope and a quartz fibre electrometer during a voyage from Havre to San Francisco *via* the Panama Canal in July and Aug., 1939. The field measured corresponded to that at 1 m. above the ground. The results are tabulated and grouped according to latitude in the two oceans, and show a sharp decrease of field near the equator. R. S. R.

4530. Statistical Study of 11-Year Cycle of Diurnal Component of Magnetic Declination. Mme. and H. Labrouste. *Comptes Rendus*, 209. *pp.* 565–568, *Oct.* 9, 1939.—Calm days are used for 22 stations between geomagnetic latitudes —48° and + 64°, and the variations in hourly mean phase and amplitude are shown in curves. The amplitude of the 11-year solar and magnetic variations changes from one station to another and for any one station varies with time and position on the globe in consequence of other long-period variations, but it increases with geomagnetic latitude to 50° and appears stationary or even decreases from 50° to 64°. The 11-year phase component is sensibly in phase with the solar variation except for Huancayo and Apia, but with a distribution in longitude with a positive anomaly for American stations and a negative anomaly for European. A similar study for all days is being undertaken. R. S. R.

See also Abstracts 4508, 4509.

RADIOACTIVITY.

4531. β-Ray Spectra of Mg^{27}, Cu^{62} and Nuclear Isomers of Rh^{104}. E. C. Crittenden, Jr. *Phys. Rev.* 56. *pp.* 709–713, *Oct.* 15, 1939.—The β-ray spectra of several radioactive elements have been investigated by means of a cloud chamber in a uniform magnetic field. The spectrum of Mg^{27} gave an upper limit of 1·8 eMV on the basis of 586 tracks. The spectrum of Cu^{62} gave an upper limit of 2·6 eMV on the basis of 803 tracks. The spectra of the two nuclear isomers of Rh^{104} were found to have the same upper limit and the same shape within experimental error. Their upper limits are 2·3 eMV on the basis of 524 and 529 tracks. The similarity in shape of the two spectra indicates that a direct β-transition from the 4·37-min. level does not occur to any appreciable extent and that as far as can be determined by this work the disintegration of the 4·37-min. isomer proceeds entirely by a γ-ray transition to the ground state of Rh^{104} followed by a β-transition to the ground state of Pd^{104}. AUTHOR.

4532. Derivation of Dispersion Formula for Nuclear Reactions. A. J. F. Siegert. *Phys. Rev.* 56. *pp.* 750-752, *Oct.* 15, 1939.—Kapur and Peierls [see Abstract 2395 (1938)] gave a derivation of the nuclear dispersion formula which differed from other treatments in defining the compound states by means of wave functions in coordinate space. The author has carried through the derivation starting out in a similar way, but avoiding certain disadvantages of their treatment, which mainly consist in too restricting assumptions. AUTHOR.

4533. Secondary γ-Radiation from $^{32}_{15}$P. G. J. Sizoo, C. Eijkman and P. Groen. *Physica,* 6. *pp.* 1057–1076, *Oct.,* 1939. *In English.*—γ-radiation from $^{32}_{15}$P has been investigated; secondary γ-radiation (*Bremsstrahlung*) was found both from the P atoms themselves and from external absorbing material. The intensity of the external radiation for complete absorption of the β-rays was found to be roughly proportional to Z^2/A for different absorbing elements. The energy of the internal *Bremsstrahlung* was found to be 6000 eV per disintegration electron, compared with a calculated value of 1100 eV; for the external secondary radiation the experimental value was 1000 eV compared with the calculated value of 4300 eV. The absorption of the internal radiation was somewhat less than the value calculated from the theory of Knipp and Uhlenbeck. E. E. W.

4534. Production of Positrons by β-Particles. G. J. Sizoo and F. Barendregt. *Physica,* 6. *pp.* 1085–1100, *Oct.,* 1939. *In English.*—The intensity and energy distribution of positrons produced from Ra(B+C) by internal pair production was determined by the cloud-chamber method, the results agreeing with previous determinations by this method. The positron/electron ratio (0·0103–0·0110) is, however, about 90 times larger than that found by the counter method. It is suggested that the discrepancy is due to the low average energy of a large proportion of the positrons, which for this reason are imperfectly counted by the latter method. The disagreement from theory as regards the numbers of positrons ascribable to external β- and γ-conversion in Pb, part of which have very low energies ($<$ 200 ekV) was also examined, and explanations are suggested. C. A. S.

***4535. Efficiency of Geiger-Müller Counters. R. S. Shankland and C. H. Tindal.** *Phil. Mag.* 28. *pp.* 562–570, *Nov.,* 1939.—Experiments were carried out to determine the influence of voltage and counting rate on the efficiency of the Geiger-Müller counter and to obtain further knowledge of the phenomena of the counter discharge. High voltage was supplied to the counter by a rectifier and voltage stabiliser circuit and the counter discharges were amplified by three stages of resistance-capacity amplification. The impulses were fed into a scale-of-16 circuit operating a Cenco impulse recorder. Curves are given showing the counter efficiency as a function of applied voltage for six counting rates ranging from 29 to 5×10^5 per min. The efficiency for all counting rates drops to zero at a threshold of 1175 V. For slow counting rates the efficiency reaches a value of 96% at about 1300 V, above which there is little improvement. At high counting rates the efficiency increases steadily with the applied voltage, the curves being essentially straight lines with a slope inversely proportional to the counting rate and only showing saturation at very high overvoltages sufficient to make all pulses large enough to be amplified. The counter efficiency depends also on the constants R and C of the coupling circuit. The efficiency for either single or coincidence measurements will be considerably increased for high counting rates if a vacuum tube is used in place of the high resistance normally used to quench the counter discharge. A. W.

See also Abstracts 4503, 4512, 4606, 4671, 4700, 4703.

RADIATION.

COLORIMETRY.

***4536. Four-Filter Photoelectric Colorimeter. B. T. Barnes.** *J.O.S.A.* 29. *pp.* 448–452, *Oct.*, 1939.—Details are given of the construction, including specifications of the glass filters. Operation, calibration and performance are described. So far the instrument has been used with fluorescent lamps only. S. J. G.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4537. Rectilinear Magnetic Dichroism in Liquids with Wide Absorption Bands. M. Schérer. *Comptes Rendus*, 209. *pp.* 411–413, *Aug.* 28, 1939.—It was surmised that in liquids such as salt solutions having wide absorption bands, in which the author has already shown circular magnetic dichroism to exist, there should also be a transverse effect [see Abstract 562 (1933)]. This effect has now been found with cobalt nitrate which has a rectilinear dichroism showing a maximum at about 5000 Å and having the same sign throughout. Magnetic birefringence is also shown of the same sign as nitrobenzene but much smaller. J. E.

4538. Magneto-Optical and Natural Dispersions of Isobutyl Butyrate and Ethylene Chloride. W. J. G. Beynon. *Phil. Mag.* 28. *pp.* 548–561, *Nov.*, 1939.—Formulæ are given for the magneto-optical dispersions of isobutyl butyrate and ethylene chloride over the range of wave-lengths from $0 \cdot 43\mu$ to $0 \cdot 31\mu$, for the natural dispersion of isobutyl butyrate over the range $0 \cdot 67\mu$ to $0 \cdot 30\mu$ and of ethylene chloride over the range $0 \cdot 44\mu$ to $0 \cdot 30\mu$. In the case of the refractive indices of ethylene chloride in the visible spectrum it was found that the formula gave values below those actually observed. It would hence appear that if more accurate and extensive data were available the formulæ given in this paper would be found to be inapplicable. For both liquids the calculated value of Verdet's constant for a wave-length in the visible spectrum well outside the range of the present investigation is in satisfactory agreement with that actually observed. From this it is inferred that absorption bands in the infra-red have no appreciable effect on the magneto-optical and natural dispersions in the visible and ultraviolet regions of the spectrum. A table is given comparing the formulæ constants for isobutyl butyrate with those for butyric acid and other butyrates. The values of e/m calculated from the results are $1 \cdot 018 \times 10^7$ e.m.u. and $1 \cdot 028 \times 10^7$ e.m.u. for isobutyl butyrate and ethylene chloride respectively. These figures indicate that the resonators controlling the dispersion have an electronic nature, but the values are considerably lower than the accepted value for electrons ($1 \cdot 772 \times 10^7$ e.m.u.). Similar low values of e/m have been obtained from magneto-optical work by other observers. A. W.

4539. Magnetic Rotatory Dispersions of C_6D_6 and of C_2D_5OD. G. Dupouy. *Comptes Rendus*, 209. *pp.* 453–455, *Sept.* 11, 1939.—The magnetic rotatory powers of C_6D_6 and of C_2D_5OD for five visual wave-lengths between 5893 and 4358 Å are recorded at 15·5° C. and 71° C., and at 2° C. and 70° C. respectively. The temperature has no effect on the dispersion. [See following Abstract.] C. B. A.

4540. Temperature Variation of Magnetic Rotatory Powers of C_6D_6 and of C_2D_5OD. C. Fert. *Comptes Rendus*, 209. *pp.* 479–480, *Sept.* 18, 1939.—The Verdet constants of C_6D_6 and of C_2D_5OD for the Hg line 5461 Å vary linearly with temperature up to 71° C. [See preceding Abstract.] C. B. A.

4541. Magnetic Rotatory Power of $NiSiF_6,6H_2O$ Along the Optic Axis at Temperatures down to 1·6° K. J. Becquerel and J. van den Handel. *Physica*, 6. *pp.* 1034–1038, *Oct.*, 1939. *In French.*—The authors have measured the magnetic rotatory power of a small crystal of $NiSiF_6.6H_2O$ along the optic axis at temperatures down to 1·6° K. The rotatory power is positive at all temperatures and increases regularly as the temperature falls. The authors cite this as the first case of paramagnetic rotatory power in the positive sense. [See following Abstract.] G. E. A.

4542. Paramagnetic Rotatory Power and Magnetisation of $NiSiF_6,6H_2O$ along the Optic Axis. The Crystalline Field. J. Becquerel and W. Opechowski. *Physica*, 6. *pp.* 1039–1056, *Oct.*, 1939. *In French.*—The experimental results obtained for the above substance [see preceding Abstract] may be explained if it is assumed that the fundamental state of the Ni^{++} ion in the fluosilicate is doubly degenerated and that this is closely followed by a non-degenerated state. With this assumption the law of magnetisation and that of magnetic rotation are found. The magnetic moment for the fundamental level is then $2{\cdot}25\mu_B$, and the limiting effective moment $3{\cdot}185\mu_B$. It is very probable that the crystalline electric field acting on the Ni^{++} ion is octahedral with a much weaker trigonal field superposed. The energy levels of Ni^{++} are as indicated and the extent of the decomposition of the fundamental state ^3F of the free Ni^{++} ion in the crystalline field is 19200 cm^{-1}. This result is in good agreement with previous purely magnetic measurements on other Ni salts. G. E. A.

See also Abstract 4566.

EMISSION.

4543. Representation of the Wave Equation and Development of Electromagnetic Quantities in the Theory of the Photon. G. Petiau. *J. de Physique et le Radium*, 10. *pp.* 413–419, *Sept.*, 1939.—The solution of de Broglie's wave-equation for the photon is given in terms of initial conditions expressed as a Fourier series of a function of the space-coordinates. The solution can also be expanded in terms of a complete system of 16 Hermitian matrices. It is then shown that some of these fundamental matrices can be interpreted as components of the electromagnetic field whilst the rest are components of a non-maxwellian field. The plane-wave-solution of the de Broglie equation is then studied in detail and it is proved that such a wave having spin + 1 or − 1 in the direction of propagation is a transverse wave whilst one having spin 0 in that direction is longitudinal. G. C. McV.

4544. Spectral Emission of Ni at Various Temperatures. F. Cennamo. *N. Cimento*, 16. *pp.* 253–260, *May*, 1939.—The emission of Ni has been determined experimentally from 1–7μ for temperatures above the Curie-point. It is found that between the temperatures 593° K. and 1145° K. the following connection between the temperature T and the wave-length at maximum emission λ_m obtains: $\lambda_m T \doteq 0{\cdot}060T^{0.219}$. The reflective power of Ni is calculated from the experimental data at the temperatures under consideration and its variation with temperature is shown in curves. [See Abstract 3990 (1939) and following Abstract.] L. K.

4545. Emission of Ni and its Variation with Temperature. F. Cennamo. *N. Cimento*, 16. *pp.* 294–298, *June*, 1939.—It is shown that the measurements of the variation of the maximum emission of Ni with temperature [see preceding Abstract] satisfy the relation $e_{\lambda_m}T =$ const. $T^{5.85}$ in the temperature interval 600°–1150° K. L. K.

4546. Asymptotic Orbits in the Theory of Primary Cosmic Radiation. A. Baños, Jr. *J. Math. Phys.* 18. *pp.* 211–238, *July*, 1939. —Calculations are made of asymptotic orbits by the Lemaître-Vallarta method of numerical integration, bisecting the interval of integration as many times as might be required to exhaust fully the practical possibilities of the method. By carefully drawing the complete families of asymptotic orbits for $\gamma_1 = 0{\cdot}85$, comparison was made with the trajectories computed by the differential analyser. It was concluded that the trajectories obtained mechanically are sufficiently precise for all practical purposes associated with the theory of the main cone of allowed directions. D. H. F.

4547. Geometry of Counter Arrangements and Angular Divergence of Penetrating Showers. G. Cocconi. *N. Cimento*, 16. *pp.* 299–304, *June*, 1939.—The probability of registering a two-particle shower with a coincidence set consisting of 2 parallel counters in a horizontal plane is appreciably greater for small angle showers (observed when the distance between the counters is small) than for wide angle showers (distance between the counters large). In a special case (for counters of 30 cm. × 3 cm. effective length and width) curves are given showing, for different positions of the counters, the variation of the probability of registration with the distance between the two points in which the tracks of the shower particles intersect the horizontal plane of the counters. A correction taking this effect into account is applied to the results of Nielsen and Morgan who found a relative frequency of 2·4 : 1 for penetrating two-particle showers of 7° and 28° divergence respectively [see Abstract 2852 (1939)]. The corrected value of this ratio is 2·4 : 3·4, that is, the wide angle showers appear now to be not less but more frequent than the small angle ones. L. E. F.

4548. Effects of Nuclear Exchange Forces in Cosmic Radiation. M. Ageno. *Ricerca Scientifica*, 10. *pp.* 675–679, *July–Aug.*, 1939.—According to Bhabha, if exchange forces exist between neutron and proton, a very fast particle of the one species traversing matter should occasionally transfer practically all its energy to a particle of the other species, so that what appears to be one track of a heavy particle actually should consist of a succession of alternating neutron and proton tracks of a few cm. average length in Pb. This prediction can be checked experimentally by putting up three Geiger-Müller counters in a vertical file, with blocks of Pb interposed, and observing the number of coincidences of the outer counters during which there is no discharge in the middle one. This was previously done indirectly by comparing the number of double and triple coincidences. The present author, in order to increase the accuracy of measurement, observed this number directly by means of a "coincidence-anticoincidence" set counting coincidences and "anticoincidences" simultaneously. Special care was taken to avoid the counting of particles scattered in the Pb. Some counts were taken with one of the Pb blocks out. In this case the number of anticoincidences gives a measure for the yield of the middle counter (which is slightly less than unity). It results that the effect of exchange forces does not amount to more than 0·3%. If exchange forces between neutron and proton are assumed it follows that the intensity of protons of relativistic energy present in the hard component of the cosmic radiation does not exceed 1%. L. E. F.

4549. Relative Intensity of Soft and Hard Component of Cosmic Radiation. B. N. Cacciapuoti. *Ricerca Scientifica,* 10. *pp.* 680–683, *July–Aug.,* 1939.—Coincidence counter measurements carried out in 4 different heights, from 50 to 950 m. above sea-level, show that the ratio of the intensities of soft and hard component increases by 30% over the whole of this interval, while only an increase of about 10% should be expected according to the theory of the mesotron. It appears doubtful whether at sea-level the two components are in equilibrium. L. E. F.

4550. Absorption of Hard Component of Cosmic Radiation and the Nature of the Mesotron. G. Bernardini, B. N. Cacciapuoti and O. Piccioni. *Ricerca Scientifica,* 10. *pp.* 809–812, *Sept.,* 1939.—If the electronic component of the cosmic radiation is due mainly to decayed mesotrons, its relative intensity should vary with the density of the medium traversed from about 20% in air at sea-level down to about 5% in water and absorbers of higher density. The first of these numbers is in good agreement with experimental data. In order to test the second prediction, absorption experiments were carried out at 2000 m. above sea-level. The relative intensity of the soft component under more than 1 m. of earth was still 25% ; an equivalent thickness of air (~ 1700 m.) would have produced the same result. So it appears that the expected variation with density does not exist. L. E. F.

4551. Penetrating Components of Large Cosmic-Ray Showers. P. Auger and J. Daudin. *Comptes Rendus,* 209. *pp.* 481–483, *Sept.* 18, 1939.—Using a counter controlled expansion chamber, results confirming earlier work [see Abstract 238 (1939)] are obtained, pointing to the conclusion that electrons of high energy and not mesons constitute the greater part of the penetrating component of cosmic rays. The existence of the phenomenon at the height of the Jungfraujoch indicates that the primary electrons have energies of 10^{13} eV unless the creation of meson intermediaries plays some rôle. The frequent occurrence of slow protons in large cosmic-ray showers indicates that the latter contains some radiation which interacts strongly with the nucleus. F. C. C.

4552. Variations in Large Cosmic-Ray Showers with Barometric Pressure, Altitude and Time. P. Auger, Robley and Pluvinage. *Comptes Rendus,* 209. *pp.* 536–538, *Oct.* 2, 1939.—From experiments at Paris (I) and Pic-du-midi (II) (atm. pressure resp. 10·3 and 7·3 m.H_2O) it is shown that the number of large showers, N, recorded at II is approximately three times that at I (180 and 67), while the density of a shower at II is twice that at I ; the number of coincidences per hr. at the two places are, with two counters, (n_2), 24·1 and 7·5, and with three counters (n_3), 8·9 and 2·5 respectively. Variations of n_2 at the same place follow closely variations in barometric pressure, but appear to be quite independent of temperature. There is also no measurable diurnal variation in N. It may therefore be concluded that the directions of propagation of cosmic rays throughout the energy spectrum are distributed isotropically in space far from any celestial body. [See Abstract 1138 (1939).] C. A. S.

See also Abstracts, 4456, 4457, 4559, 4602, 4670.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4553. Influence of Ionic Strength on Quenching of Fluorescence in Aqueous Solutions. R. W. Stroughton and G. K. Rollefson. *Am. Chem. Soc., J.* 61. *pp.* 2634–2638, *Oct.,* 1939.—The quenching constants at various values of ionic strength were determined for the quenching of fluorescence of quinine sulphate by KCl, KBr and $AgNO_3$, of fluorescein by KI in acid and basic solutions; of acridone by KI and $AgNO_3$; of anthracene sulphonic acid by KI and $AgNO_3$ and of acridone sulphonic acid by KI, KCNS and $AgNO_3$. The values of $(2/\Delta z^2)\log k$ were plotted against $\mu^{1/2}$ and in every case the curves obtained were of the same type as those expected for an ordinary bimolecular reaction. Absorption measurements were made with the dye solutions in the presence and absence of the quenching ions. Only a negligible change of absorption was observed, thus eliminating the possibility of explaining the quenching as due to complex formation of the dye with the quencher before excitation of the former. The quenching in all cases appeared to be due to an ordinary bimolecular reaction between the quenching ion and the activated dye molecule. AUTHORS.

4554. Dielectric Losses of Irradiated ZnS Phosphors. J. H. Gisolf. *Physica,* 6. *pp.* 918–928, *Oct.,* 1939. *In English.*—There are three different absorption regions in the absorption spectrum of ZnS.MnS phosphors. (1) A series of bands characteristic of the Mn ion, (2) the crystal absorption of ZnS at about 3100 Å, and (3) a long-wave tail of the latter. The alteration of the dielectric constant and the dielectric losses for radiation in these three regions has been studied under alternating fields of from 10^3 to $1\cdot5 \times 10^7 \sim$. No alterations are found under irradiation in the region (1) indicating that the luminescence characteristic of Mn is due to excitation of the Mn ion without the production of free charges. In the other two regions however the luminescence is related to changes of the dielectric properties. In the region of the characteristic crystal absorption the difference in the dielectric losses in the irradiated and dark states follows a normal course with change of frequency, but in the tail region, where the phosphorescence is mainly shown, the curve showing the difference of dielectric losses against frequency follows a complicated course. These results are taken to imply that the crystal absorption results in a bimolecular light emission (recombination of conduction electrons with electron poles) while the tail absorption gives rise to both the bimolecules process and the phosphorescence process. The suggestions are developed mathematically and a value of 5×10^4 obtained for the crystal absorption coefficient. J. E.

4555. Proportionality of Luminescence to Irradiation at Low Temperatures of ZnS Phosphors. J. H. Gisolf and F. A. Kröger. *Physica,* 6. *pp.* 1101–1111, *Oct.,* 1939. *In English.*—With ZnS phosphors which emit more than one band simultaneously there are deviations from proportionality between the excitation and emission at low intensities, giving rise to alterations of colour with changes of excitation intensity. Examples studied in detail are ZnS.MnS with very little Mn and ZnS.Cu with very little Cu and ZnS.Ag with Cu impurity. The results are shown to be explicable as due to the concurrence of phosphorescence and fluorescence if it is assumed that both these processes are excited by the same absorption process. The effect of temperature and a mathematical formulation of the phenomena are discussed. J. E.

4556. Infra-Red Radiations and Their Quenching Effects upon ZnS Phosphors. G. G. Blake. *Roy. Soc. N.S. Wales, J. and Proc.* 73. *pp.* 112–124, 1939.—New symbols are proposed to denote energised (*), and non-energised (⊙), phosphors. Under the title of "shift of spectral distribution" a new effect is observed. An incandescent lamp is run in series with a variable resistance X Y. The spectral distribution of the light is altered by setting the sliding-contact of the former to any position Z (at random) between X and Y. A ZnS screen is energised at this setting. Z is then moved nearer to X and the screen re-exposed. This results in a quenching of its luminosity. A reversal of the process, i.e. the displacement of Z towards Y gives an increased luminosity. A new photographic process is described based upon this effect. An ordinary finished negative is printed by contact on to a ZnS-Cu* screen. According to the position of sliding contact Z, either a negative or a positive phosphorescing picture is obtained. Control of contrast is provided and a method of intensification by heat. Examples of phosphorographs (contact prints on to panchromatic plates and paper) are given. A method of making phosphorescent screens is described with experiments demonstrating infra-red quenching, increased luminosity by heat, reversal of image effect and its interpretation, revelation of chromatic aberration and astigmatism by a ZnS-Cu* screen, control or inhibition of fluorescence by infra-red radiation, comparison of the scattering of blue and infra-red radiations, comparison of focal lengths of lenses to these radiations by phosphorographic method. The effects of dark-heat and radiations from a body at 500° C. upon an energised phosphor are shown. Comparative spectrographs are given for ZnS and CaS. The selective action of a composite screen of ZnS (green and yellow) is shown. The transparency to infra-red of black glass, ebonite, paper and of various paints is discussed. A ZnS-Cu* screen is invisible through red glass. It is shown that phosphorescent luminosity is not transmissible from one screen to another, it is a surface effect. Fluorescence precedes quenching. Le Bon's method of making infra-red radiographs is described and a number of useful references are given. The investigations are still proceeding. AUTHOR.

See also Abstract 4642.

INTERFERENCE, DIFFRACTION AND SCATTERING.

4557. Haidinger's Rings in Curved Plates. C. V. Raman and V. S. Rajagopalan. *J.O.S.A.* 29. *pp.* 413–416, *Oct.*, 1939.—The paper describes and illustrates the Haidinger interference patterns observed in curved plates of uniform thickness but of arbitrary form, and discusses their theory. Using an illuminated screen as light source and a limited viewing aperture, it is possible to observe such patterns with curved plates, their configuration depending upon the form of the plate as well as the position of the aperture with reference to the centres of curvature of the surface of the plate. It is pointed out that the interference pattern for a curved plate is geometrically similar in form to the image of the standard Haidinger pattern of circular rings as seen viewed by reflection at the appropriate distance from the curved surface of the shell. AUTHORS.

See also Abstracts 4499, 4500, 4569, 4573, 4643 and

2627B. Light Scattering by Road Surfaces. A. Bloch.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4558. U.V. Irradiation of Rubber. P. S. Srinivasan. *Indian Acad. Sci., Proc.* 10*A*. *pp.* 186–196, *Sept.*, 1939.—The absorption of light by rubber when dissolved in polar and non-polar solvents is measured before and after exposing the solutions to u.v. light in the absence of air. It is found that irradiation with u.v. light makes rubber more transparent when in non-polar solvents and less transparent when in polar solvents. The state of rubber in solution is reviewed in the light of present-day knowledge and a tentative explanation of the absorption phenomenon is suggested on the assumption that the rubber molecule in a polar solvent is depolymerised by the field of the solvent molecule and that u.v. light produces both polymerisation and depolymerisation of rubber according as rubber initially is in a low or high state of polymerisation. A probable support to this conception from measurements of viscosity is indicated. AUTHOR.

4559. U.V. Emission in Thermolysis of Ferric Azide. C. Racz. *Comptes Rendus*, 209. *pp.* 534–536, *Oct.* 2, 1939.—Decomposition of ferric azide is accompanied by strong u.v. emission ; the energies of activation are 47 ± 3·5, 33·5 ± 4·5 and 64 ± 5 kg.cal. ; emission begins at 270° and the transition points are 303 ± 4° and 334 ± 5·6°. But if the azide has been heated to 310° and cooled emission only begins at 305°, and only activation energies of 34 ± 1 and 75 ± 5 are found. In a closed vessel with air or N_2 it explodes at about 200°, but in a current of N_2 at about 230°, in which case u.v. emission is a maximum at about 210°, then falling to zero but reappearing on admission of air. By comparison with results with other azides it is inferred that the processes connected with the energies of activation 64 and 47 kg.cal. are independent of the metal, while that of 33 indicates some different mechanism of thermolysis. [See Abstract 3266 (1939).] C. A. S.

4560. Theoretical Treatment of the Two-Quanta Hypothesis as Applied to the Photographic Reciprocity Law Failure. L. Silberstein. *Kodak Research Lab. Comm. No.* 744. *J.O.S.A.* 29. *pp.* 432–447, *Oct.*, 1939.—According to the reciprocity law the density of the image should depend only on the total exposure y, *i.e.* on the product of the light intensity i and the exposure time t, and not on their individual values ; actually, however, it is known experimentally that the probability P that a grain shall become developable by a given total exposure y decreases with increasing i when i is below an optimum value. Starting from the assumption (for which evidence is given) that the absorption of at least two quanta within a definite time interval τ is required for the developability of a grain, an equation is derived connecting P, y, t and τ. The equation is able to explain the reciprocity breakdown qualitatively and is suitable for application to further quantitative experimental tests. The possibility that τ has a minimum value also (" blocking-time " effect) is also taken into account. S. J. G.

4561. Rôle of Oxidation Products in the Process of Development. H. Staude. *Zeits. f. wiss. Phot.* 38. *pp.* 137–156, *July*, 1939.—It may be regarded as experimentally established that developers are only able to exert their developing action through their next higher oxidation products (O.P.) with which they must be able to form compounds. The existing theories of development are examined critically to see how far they can explain this fact. The primary process when radiation strikes an AgBr grain is $Br^- + h\nu = Br + e^-$, the released electron either passing completely over to an Ag$^+$ or remaining loosely bound to it (*i.e.*, sub-halide); this process occurs most readily at faults (*Lockerstellen*) such as edges, cracks, or places where certain foreign molecules, *e.g.*, Ag_2S, are adsorbed. Faults are more probable in large than in small crystals, hence their greater light-sensitivity. Now the oxidation products, having electron affinity, are easily adsorbed on to a surface where electrons are free or loosely bound, and further can form addtion products with the developer molecule, and so bind the latter. A developer molecule is thus brought into the immediate neighbourhood of an Ag$^+$ so that reduction occurs, giving rise also to another molecule of O.P., so that the process can be repeated indefinitely. The importance of the value of the redox potential is also discussed. [See Abstract 4018 (1939).] S. J. G.

4562. Effect of Grain Size on Finishing of Photographic Emulsions. A. P. H. Trivelli and W. F. Smith. *Kodak Research Lab. Comm. No.* 704. *Phot. J.* 79. *pp.* 609–612, *Nov.*, 1939.—It was found that in the emulsion series investigated the sensitivity factor of the gelatin drops rapidly in the very fine-grain emulsions. This suggested an investigation of the rate of increase in speed and gamma during finishing of these emulsion series. Two emulsion series, each consisting of seven emulsions, were prepared in the same way. One series contained less silver iodide than the other. Each series was finished with a different high-speed gelatin. It has been found in these two emulsion series that during finishing :–(1) the H. and D. speed of the smaller-grain emulsions increases more than that of the larger-grain emulsions; (2) the gamma of the smaller-grain emulsions increases less than that of the larger-grain emulsions. AUTHORS.

4563. Influence of Pressure and Development on the Solarised Latent Photographic Image. A. J. Reardon. *J.O.S.A.* 29. *pp.* 427–431, *Oct.*, 1939.—A special apparatus has been devised to permit the application of high uniform pressure to part of the surface of a photographic material during its exposure to light. Both bromide paper and nitrate portrait film were tested, and pressures up to 1357 kg./cm^2. were employed, exposure times varying from 1 to 950,000 sec. Both chemical and physical development were used. In all cases the density of the developed image was less in that part which had been exposed to pressure (" spot ") than in the surrounding parts (" rim "). The curves of log exposure, *vs.* density, for the rim and spot portions respectively run approximately parallel. For both rim and spot reversal effects (*fall* in density for increasing log exposure) occur with chemical but not with physical development. S. J. G.

See also Abstract 4617, and

2580B. 120,000-Exposure-per-Second Camera. D. C. Prince and W. K. Rankin.

PHOTOMETRY.

***4564. Objective Photometer. R. Vosinskij.** *J. Techn. Phys. U.S.S.R.* 9. 4. *pp.* 352–361, 1939. *In Russian.*—An improved photometer of a type described by Sharp and Smith [see Abstract 1454B (1928)] is described. D. S.

See also Abstract

2624B. Specification Points of Brightness. H. L. Logan.

POLARISATION.

4565. Optical Anisotropy and Structure of Cellulosic Sheet Materials. J. Spence. *Kodak Research Lab. Comm. No.* 700. *J. Phys. Chem.* 43. *pp.* 865–879, *Oct.*, 1939.—The evaluation of the birefringence of sheet materials is described and the general considerations in its structural interpretation are discussed and demonstrated. AUTHOR.

4566. Measurement of Small Optical Activities with Quartz Crystal Light Modulator. D. W. R. McKinley. *Canad. J. of Research,* 17. *Sect. A. pp.* 202–207, *Oct.*, 1939.—An experimental procedure is described for using the quartz crystal light modulator as an instrument for measuring very small optical rotations of the plane of polarisation. The accuracy of the measurement is of the order of 10 sec. of arc, and the method is capable of still greater precision. An elementary analysis of the crystal behaviour explains the fundamental and second harmonic components of light intensity present in the modulated beam of light. [See Abstract 2841 (1938).] AUTHOR.

4567. Intramolecular Asymmetric Induction. A. McKenzie and A. D. Wood. *Chem. Soc., J. pp.* 1536–1544, *Oct.*, 1939.—The (−)menthyl and the (−)bornyl ester of 4 : 4′-dinitrodiphenic acid were prepared, and their rotatory powers were contrasted with those of the corresponding esters of *m*-nitrobenzoic acid and phthalic acid. These esters were all lævorotatory in the solvents chosen, and there was no evidence that intramolecular asymmetric induction of 4 : 4′-dinitrodiphenic acid had occurred under the directing influence of the optically active menthyl and bornyl groups. The conclusion is drawn that Kuhn's suggestion of *asymmetrische Umlagerung erster Art* with 4 : 4′-dinitrodiphenic acid under the influence of quinine must remain an open question meantime. The isomeric optically inactive esters, (+)bornyl (−)bornyl 4 : 4′-dinitrodiphenate and *dl*-bornyl 4 : 4′-dinitrodiphenate, were prepared. AUTHORS.

4568. New Method of Resolving a Racemic Compound. G. M. Henderson and H. G. Rule. *Chem. Soc., J. pp.* 1568–1573, *Oct.*, 1939.—*dl-p*-Phenylenebisiminocamphor is shown to be resolvable by taking advantage of the difference in the adsorption coefficients of the *d*- and the *l*-form for solid lactose. The racemic compound is adsorbed in the upper part of an upright tube filled with lactose, and the adsorbed layer is washed with solvent until it has expanded to the full length of the tube. Material recovered from the upper portion of the tube is found to be dextrorotatory and that from the lower portion lævorotatory. The degree of rotation can be increased by repeating the process until the optically pure product is obtained. The process is obviously limited to racemic compounds which can be adsorbed on an optically active adsorbent and whose active components possess different adsorption coefficients. AUTHORS.

See also Abstracts 4588, 4597, 4663.

REFLECTION, REFRACTION AND DISPERSION.

4569. Optical Properties of Semi-Transparent Sputtered Films Determined by Interference of Light. J. B. Nathanson and C. L. Bartberger. *J.O.S.A.* 29. *pp.* 417-426, *Oct.*, 1939.—A study has been made of the optical properties of semi-transparent films of variable thickness produced by sputtering in H_2. The masses of the films have been computed from the assumed optical constants and densities of the metals, and from the locations of the interference fringes, when the films are viewed by reflected monochromatic light at approximately normal incidence. With few exceptions the computed masses are much greater than the masses determined directly by weighing. The differences between the computed and weighed masses can be accounted for by assuming higher refractive indices and lower densities of the films than those assumed for the bulk metals. Such would be the case if the films were composed of compounds, *e.g.*, oxides of the metals. This has been verified by a colorimetric analysis of the iron films. Further confirmation is supplied by a study of the optical dispersion of the films, which seems to be characteristic of transparent insulators rather than of the metals. High refractive indices are also called for from a consideration of the ageing of a Pt film. A mathematical analysis of the reflectivity of the films has been made, based upon the consideration of multiple reflections within the films. To account for the number of fringes observed, very low indices of absorption must be assumed, such as those possessed by transparent insulators. AUTHORS.

***4570. Optical System with Variable Magnification. S. Maruyama.** *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 485–494, *Aug.*, 1939. *In English.*—A mathematical study has been made of optical systems with variable magnification in which the image of a given object is formed at the same point. Two classes are considered, *viz.*, systems with two magnifications and those with continuously variable magnification. In the former class, a single positive erecting lens is used magnifying in one position and reducing in the other symmetrical position. In the second class, an erecting system composed of two lens systems is considered, these systems moving as a whole and changing the mutual distance at the same time in order to vary the magnification. Finally the author deals with the problem of focal length determination for the component lenses. H. H. Ho.

4571. Normal Systems with Two Caustic Lines. M. Herzberger. *Kodak Research Lab., Comm. No.* 734. *J.O.S.A.* 29. *pp.* 392–394, *Sept.*, 1939.—Discussing normal systems an examination is made of one aspect of the Sturm conoid conception. The paper is entirely mathematical in character. A. H.

4572. Theory of Image Errors of the Fifth Order. M. Herzberger. *Kodak Research Lab., Comm. No.* 735. *J.O.S.A.* 29. *pp.* 395–406, *Sept.*, 1939.—The Seidel theory (or theory of third-order aberrations) becomes of less and less use as the field and aperture of an optical instrument is increased. It becomes necessary either to trace a considerable number of skew rays or to develop a theory of the image errors of the fifth or higher order. The latter alternative is here attempted. A. H.

4573. Adiabatic Piezo-Optic Coefficients of Water and Alcohols. K. S. Venkataraman. *Indian Acad. Sci., Proc.* 10*A*. *pp.* 120–140, *Sept.*, 1939.—The adiabatic piezo-optic coefficient defining the change of refractive index of liquids due to adiabatic compression has been measured for seven members of the series of alcohols by the method developed in an earlier paper [see Abstract 2519 (1939)], and the results for water have been added for comparison. The values of the adiabatic piezo-optic coefficients, $(\partial\mu/\partial p)_\varphi \times 10^6$ are 34·52 for methyl alcohol at 24·4° C., 36·12 for ethyl alcohol at 24·0° C. 33·54 for *n*-propyl alcohol at 24·1° C., 37·30 for *iso*-propyl alcohol at 25·5° C., 32·95 for *n*-butyl alcohol at 24·5° C. 36·07 for *iso*-butyl alcohol at 25·5° C., 34·15 for *n*-amyl alcohol at 26·1° C., and 14·66 for water at 23·1° C. The temperature coefficients of refractive indices, $(\partial\mu/\partial t)p \times 10^5$ for the various alcohols were $-37·5$, $-39·8$,

$-40\cdot5$, $-43\cdot5$, $-41\cdot1$, $-41\cdot8$, $-41\cdot1$ respectively. The experimental results are discussed with reference to (*a*) the deviations from the Lorentz refraction formula and (*b*) the temperature variations of refractive index at constant density. The elasto-optic coefficients calculated for pressure changes at constant temperature and at constant entropy are always higher than the theoretical value given by the Lorentz formula and the difference between that at constant temperature and the theoretical value, which is due to the anisotropy of the polarisation field is considerably smaller in the alcohols than in CS_2 or benzene. The elasto-optic coefficient calculated for temperature changes steadily approaches the value given by the Lorentz formula on proceeding up the series of alcohols. The pure temperature coefficient of refractive index is positive in methyl and ethyl alcohols, being larger in the former. It is negative from *n*-propyl alcohol onwards and increases in magnitude in the normal alcohols.

AUTHOR.

4574. Dispersion Curves of H_2 and D_2, and of H_2S and D_2S in the Visible. O. E. Frivold, O. Hassel and E. Hetland. *Physica*, 6. *pp.* 972–976, *Oct.*, 1939. *In German.*—Previous work [see Abstract 1195 (1939)] has been extended, and data on H_2 and D_2 are also given. Values of $\triangle n_0$ for $n_{0H_2} - n_{0D_2}$, and $n_{0H_2S} - n_{0D_2S}$ are recorded for seven wave-lengths from 4200 to 7000 Å; for both $\triangle n_0$ increases continuously towards shorter wave-lengths. For $5460\cdot8$ Å the values of $(n_0 - 1) \times 10^6$ are $139\cdot37$ and $137\cdot58$ for H_2 and D_2 respectively. Values of n_0 and *R* are recorded for six wave-lengths from $4046\cdot6$ to $6562\cdot9$ Å for H_2 and D_2.

W. R. A.

***4575. Rhodium Mirrors. M. Auwärter.** *J. of Applied Physics*, 10. *pp.* 705–710, *Oct.*, 1939.—A general survey is given of the methods of making mirrors by metallic deposition and then a review is made of the available metals from the view points of reflection coefficients, ageing, etc. Rh mirrors, it is pointed out, retain their reflecting powers unaltered, regardless of the nature or condition of the surrounding atmosphere or medium. Rh also exhibits extraordinary adhesion to its support. Semi-transparent Rh mirrors are also discussed.

A. H.

See also Abstracts 4538, 4661, 4662.

SPECTROSCOPY.

4576. Relative Intensity of Spectral Lines. F. H. Newman. *Phil. Mag.* 28. *pp.* 584–587, *Nov.*, 1939.—Discusses at length the previous work on the effect of components in a mixture on spectral line intensities. Work on the relative intensities of the spectral lines of alkali amalgams is then described. It is found that the lines of the alkali component show a marked relative increase in intensity—compared with Hg lines—as the temperature of the amalgam is increased. It is also observed that with an uncondensed discharge the alkali lines are comparatively strong, whereas with a condensed discharge they are suppressed, leaving only the Hg lines.

A. H.

4577. Determination of Spectroscopic Pattern. D. S. Evans. *Observatory*, 62. *pp.* 231–234, *Sept.*, 1939.—The use of an absorption line for the determination of an instrumental pattern makes the errors of determination of the pattern, and reduction of the absorption lines, work in opposite directions and tend to cancel out. Details are accordingly given

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of the observation of the contours of the D-lines and the use of these in the solution of the integral equation connecting true and observed contour.

A. H.

4578. Magnetic Moments of Proton and Deuteron. Radiofrequency Spectrum of H_2 in Magnetic Fields. J. M. B. Kellogg, I. I. Rabi, N. F. Ramsey, Jr. and J. R. Zacharias. *Phys. Rev.* 56. *pp.* 728–743, *Oct.* 15, 1939.—The molecular-beam magnetic-resonance method for measuring nuclear magnetic moments [see Abstract 2090 (1939)] has been applied to the proton and the deuteron. In this method the nuclear moment is obtained by observing the Larmor frequency of precession ($\nu = \mu H/hI$) in a uniform magnetic field. For this purpose HD and D_2 molecules are most suitable because they are largely in the state of zero rotational momentum. Very sharp resonance minima are observed which makes it possible to show that the observed values of ν/H are independent of H, and to make a very accurate determination of the ratio μ_P/μ_D. With molecules of ortho-hydrogen in the first rotational state a radiofrequency spectrum of six resonance minima was obtained. This spectrum when analysed yields a set of nine energy levels from which are obtained (1) the proton moment from its Larmor precession frequency; (2) the proton moment from the magnitude of the dipole interaction between the two proton magnetic moments (the directly measured quantity is μ_P/r^3); and (3) the value of the spin orbit interaction constant of the proton moment with the rotation of the molecule or the magnetic field H′ produced by the rotation of the molecule at the position of the nucleus. The numerical results are $\mu_P = 2{\cdot}785 \pm 0{\cdot}02$ nuclear magnetons; $\mu_D = 0{\cdot}855 \pm 0{\cdot}006$ nuclear magneton; $(\mu_P/\mu_D) = 3{\cdot}257 \pm 0{\cdot}001$; $H' = 27{\cdot}2 \pm 0{\cdot}3$ gauss; $\mu_P/r^3 = 34{\cdot}1 \pm 0{\cdot}3$ gauss which gives $\mu_P = 2{\cdot}785 \pm 0{\cdot}03$ nuclear magnetons. To within experimental error there is no disagreement of the results of these direct measurements with those from atomic beam measurements of the h.f.s. $\Delta\nu$ of the ground states of H and D.

AUTHORS.

4579. Structure of Iridium Lines. L. Sibaiya. *Phys. Rev.* 56. *pp.* 768–769, *Oct.* 15, 1939.—The isotopic constitution of Ir was for the first time determined by Venkatesachar and Sibaiya from a study of the hyperfine structure of its arc line 3513·67 Å. It was shown that Ir consists of two odd isotopes of mass numbers 191 and 193, the isotope 193 being twice as abundant as the isotope 191. This result was afterwards corroborated by Dempster's mass-spectrograph analysis. With the view of determining the ratio of the nuclear magnetic moments of the two isotopes, the hyperfine structure, arising from the nuclear spin moments of $(\frac{1}{2})(h/2\pi)$ and $(\frac{3}{2})(h/2\pi)$ of the isotopes 191 and 193, respectively, has been investigated for a few more Ir lines using an aluminised Fabry-Perot etalon. From the results obtained for the hyperfine level separations of the isotopes, it is concluded that the ratio of the nuclear magnetic moments of Ir (191) and (193) is $-0{\cdot}92$.

AUTHOR.

4580. Integration of Equation of Formation of Absorption Lines. H. R. Hulme. *Roy. Astron. Soc., M.N.* 99. *pp.* 730–732, *Oct.*, 1939.—In the integration of the equation of the formation of absorption lines, the special case in which $1/(1+\eta) = a + \beta\tau + \gamma\tau^2$ is discussed. A brief account is also given of the possibility of using the differential analyser to solve the most general case.

AUTHOR.

4581. Structure of Triplet Bands ($d^3\Pi \rightarrow a^3\Pi$) of CO. L. Gerö with F. Szabó. *Ann. d. Physik*, 35. 7. *pp*. 597–618, *Aug*., 1939.—The triplet bands of CO are excited with high intensity and photographed with high dispersion. The rotation structure is analysed; the bands are ascribed to a $d^3\Pi_{\text{inverted}} \rightarrow a^3\Pi_{\text{normal}}$ transition; 27 branches are observed, which on account of the Λ-separation are themselves double; the Λ-separation of the upper $d^3\Pi_{\text{inverted}}$ state is immeasurably small. The results of analysis of the (0,0), (1,0), (3,0), (4,0) and (6,1) bands are presented in tabular form. The coupling parameter γ increases with increasing vibrational quantum number. There is a perturbation in the (3,0) band ascribed to a crossing over of the $d^3\Pi$ ($v = 3$) state with the $a^3\Pi$ ($v = 12$) state. J. E. K.

4582. Infra-Red Spectrum and Molecular Constants of NO. A. H. Nielsen and W. Gordy. *Phys. Rev*. 56. *pp*. 781–784, *Oct*. 15, 1939.—The infra-red spectrum of NO has been remeasured under high dispersion with the result that the fundamental at $5 \cdot 3\mu$ has been almost completely resolved. The absorption in this region comprises two superposed bands arising from a $^2\Pi_{1/2,\,3/2}$ electronic ground state. In the *P*, and *R* Branches a great many of the lines split up into doublets, the components of which belong to these two bands, respectively. The lines were found to fit the following two empirical formulæ:

$\nu_{\Omega=1/2}=1877 \cdot 36+3 \cdot 34\ J-0 \cdot 019\ J^2$ cm^{-1}, where $J=0, \pm 3/2, 5/2, \ldots$,
$\nu_{\Omega=3/2}=1877 \cdot 00+3 \cdot 42\ J-0 \cdot 019\ J^2$ cm^{-1}, where $J=0, \pm 5/2, 7/2, \ldots$.

An experimental curve in percent absorption against frequency in cm^{-1}. is compared with a theoretical intensity plot of the bands. From the new data some of the constants have been re-calculated, and compared with the results of the electronic band spectra. $I_0 = 1 \cdot 63 \times 10^{-39}$ gm. cm^2., $r_0 = 1 \cdot 15 \times 10^{-8}$ cm., $\nu_0 = 1891 \cdot 3$ cm^{-1}. AUTHORS.

4583. Infra-Red Absorption Spectrum of Gaseous C_2N_2. C. R. Bailey and S. C. Carson. *J. Chem. Phys*. 7. *pp*. 859–862, *Oct*., 1939.—A discussion of the thermodynamic functions of cyanogen recently appeared [see Abstract 1726 (1939)]. The re-examination of the infra-red spectrum is described. The structure of the bands is critical in arriving at a satisfactory assignment of the fundamental frequencies and the authors have been able to obtain some additional evidence on this question. AUTHORS.

4584. Vibrational Spectra of 1, 2 Dihalogen Ethanes and Internal Rotation. Ta-You Wu. *J. Chem. Phys*. 7. *pp*. 965–970, *Oct*., 1939.—On symmetry considerations, it is shown that a satisfactory assignment can be given to *all* the observed infra-red and Raman frequencies of the 1,2 dihalogen ethanes provided both the *cis*- and the *trans*-forms are assumed to exist. The potential functions for the internal rotation in such molecules derived from the temperature variation of the electric moments and from electron diffraction measurements are such, however, as to give a negligibly small number of molecules in the *cis*-configuration which is unstable. A suggestion is made to account for the apparent difference between the spectroscopic and the other evidences. AUTHOR.

4585. Infra-Red Absorption of Rare-Earth Ions. G. Rosenthal. *Phys. Zeits*. 40. *pp*. 508–511, *Aug*. 1, 1939.—The infra-red spectra of oxides of Yb, Tm, Er, Ho, Dy, Tb, Eu, Sm, Nd, Pr, and Ce dissolved in borax have been examined. All except Tb exhibit characteristic bands between $0 \cdot 7$ and $2 \cdot 0\mu$, and the wave-lengths, frequencies, and general appearances of the bands are recorded. Comparison is made with

Gobrecht's data [see Abstracts 2629 (1937) and 2455 (1938)]. The origins of some of the bands are discussed. W. R. A.

4586. Structure and Absorption Spectrum of Phthalonic Acid. Buu-Hoï and Lin-che-Kin. *Comptes Rendus*, 209. *pp*. 346–348, *Aug*. 7, 1939.—Chemical evidence and electrochemical measurements indicate that phthalonic acid exists in two forms, (i) γ-keto acid and (ii) oxylactone. The u.v. absorption spectra of the solid crystalline acid and of its aqueous and ethereal solutions closely resemble that of phthalide-3-carboxylic acid, the formula of which is similar to that of (ii). The keto-acid form, which is stable in 4% NaOH solution, gives an absorption curve very different from that of phthalide-3-carboxylic acid. Hence phthalonic acid exists principally in the solid state as an oxylactone.
W. R. A.

4587. N-H Harmonic Bands of Pyrrol at 9900 Å and Structure of Pyrrol Molecule. L. R. Zumwalt and R. M. Badger. *J. Chem. Phys*. 7. *pp*. 629–630, *Aug*., 1939.—The N.-H absorption of pyrrol vapour has been photographed at 150° and 250° using high and low dispersion in order to re-examine the conclusions of Freymann that the three bands at 9818 (strong), 9890 (weak), and 9961 Å (very faint) arose from different molecular species. With low dispersion the weak bands increase in intensity relative to the 9818 Å band indicating that the 9818 Å band is due to absorption from the ground level whilst the other two involve absorption from different excited states. High dispersion studies show that these excited states correspond with different vibrational excitation and not with different geometrical configurations of the molecule. The 9961 Å band could not be photographed under high dispersion; the two others show identical envelopes differing only in intensity and consisting of *P* and *R* branches and a narrow *Q* branch. From consideration of band spacings and intensities it is concluded that (i) the three bands form a sequence, (ii) the 9890 Å band is ascribable to a transition in which some low-frequency vibration is excited in both lower and upper levels, (iii) there is an unusually large interaction, between the N-H valency vibration and some low-frequency vibration (*ca*. 650 cm^{-1}.), (iv) there arises, from the interaction in (iii), some bending motion of the N-H linkage with respect to the rest of the molecule. W. R. A.

4588. Near Infra-Red Absorption Spectra of Pentaerythritol and Diketopiperazine Obtained with Plane Polarised Light. J. W. Ellis and J. Bath. *J. Chem. Phys*. 7. *pp*. 862–868, *Oct*., 1939.—Pentaerythritol, $C(CH_2OH)_4$, a crystalline alcohol, and diketopiperazine, $(CH_2NHCO)_2$, also crystalline, have been subjected to an infra-red absorption study with plane polarised waves in the region $1–2\cdot 5\mu$. Pronounced pleochroism is observed, and this dependence of absorption upon the plane of vibration of the electric vector, E_0, is used in identifying the bands associated with the normal vibrations of the methylene groups, CH_2, in each crystal. An interesting example of Fermi resonance arises. In pentaerythritol the appearance of pronounced absorption by perturbed OH groups when E_0 oscillates along the *c* axis indicates that the feature of the crystalline structure, deduced from an X-ray diffraction study which orients all of the OH groups at right angles to this axis, must be modified. The absence of the usual NH absorption near $1\cdot 50\mu$ supports Corey's assumption of electron resonance in diketopiperazine. AUTHORS.

4589. Infra-Red Absorption Studies of Glycols and Ethoxyalcohols. F. T. Wall and W. F. Claussen. *Am. Chem. Soc., J.* 61. *pp.* 2679–2683, *Oct.,* 1939.—The infra-red absorption spectra of CCl_4 solutions of various glycols and ethoxyalcohols have been studied in the neighbourhood of $2\cdot8\mu$. The results show that the ethoxyalcohols can associate through the formation of intermolecular hydrogen bonds. The substituted propanol and butanol can also form stable rings, whereas ethoxyethanol shows no evidence of ring formation. The glycols likewise demonstrate hydrogen bonding, but the evidence for their precise behaviour is not conclusive because of their limited solubility. AUTHORS.

4590. Infra-Red Study of Hydrazoic Acid. A. M. Buswell, G. W. McMillan, W. H. Rodebush and F. T. Wall. *Am. Chem. Soc., J.* 61. *pp.* 2809–2812, *Oct.,* 1939.—A number of frequencies have been observed for hydrogen and deuterium azides and some examples of hydrogen bonding by these molecules are shown. Certain peculiarities in the hydrogen frequencies are attributed to the non-linear character of the hydrogen azide molecule. AUTHORS.

4591. Infra-Red Absorption Spectra of Some Carboxylic Acids and of Dibenzoylmethane and Related Molecules. F. T. Wall and W. F. Claussen. *Am. Chem. Soc., J.* 61. *pp.* 2812–2815, *Oct.,* 1939.—The infra-red absorption spectra for ordinary and deuterated acetic, benzoic and propionic acid have been investigated in the " hydrogen bond " region and the results interpreted on the basis of their structures. Likewise the absorption for di-ethylmalonic and azelaic acids has been studied and discussed. Infra-red absorption measurements for dibenzoylmethane (and related molecules) suggest that dibenzoylmethane undergoes enolisation followed by hydrogen bonding. AUTHORS.

4592. $^1\Sigma\rightarrow{}^1\Sigma$ Transition of the C_2 Molecule. O. G. Landsverk. *Phys. Rev.* 56. *pp.* 769–777, *Oct.* 15, 1939.—The λ2300 " band " of the carbon arc, previously noticed by Bloomenthal and other investigators and measured by Hori, who attributed it to a C_3 molecule, has been accurately measured and analysed, using photographs taken on the 30 ft., 30000-line grating spectrograph. The analysis shows definitely that the structure consists of superposed (0, 0), (1,1), (2,2) and (3,3) headless bands of a $\Sigma\rightarrow\Sigma$ transition of C_2 (or possibly C_2^+), in agreement with the earlier diagnosis of Mulliken and Dieke. Alternate lines are missing in each series, as expected in view of the zero spin of the carbon nucleus. Most probably the transition is $^1\Sigma_u{}^+\rightarrow{}^1\Sigma_g{}^+$ of C_2. The molecular constants are very nearly equal for the upper and lower electronic states. They correspond rather closely to the average values of the same constants for other known states of C_2. The following values were obtained for the more important constants: $B_e' = 1\cdot8334$ cm^{-1}, $B_e'' = 1\cdot8223$ cm^{-1}, $a' = 0\cdot0204$, $\alpha'' = 0\cdot0195$, $r_e' = 1\cdot2382$ Å, $r_e'' = 1\cdot2419$ Å, $\omega_e' = 1748$ cm^{-1}, $\omega_e'' = 1774$ cm^{-1}, $v_0^{0,0} = 43227\cdot25$ cm^{-1}. The ω_e values were obtained indirectly from the B and D values, since only one sequence of bands could be analysed. [See following Abstract.] AUTHOR.

4593. Electronic States of Diatomic Carbon, and the Carbon-Carbon Bond. R. S. Mulliken. *Phys. Rev.* 56. *pp.* 778–781, *Oct.* 15, 1939.—It is shown that the λ2300 carbon band analysed by Landsverk [see preceding Abstract] belongs very probably to the transition $\sigma_g{}^2\sigma_u\pi_u{}^4\sigma_g$, $^1\Sigma_u{}^+\rightarrow\sigma_g{}^2\sigma_u{}^2\pi_u{}^4$, $^1\Sigma_g{}^+$. The $^1\Sigma_g{}^+$ state should lie not far above the normal state of C_2, or possibly be the normal state. Approximate energies and internuclear distances (r_0) are predicted and tabulated for all low-energy states of C_2 and C_2^+; an equation for predicting r_0's is given. C-C bond distances in polyatomic C compounds are compared with those in C_2. Apparently bonding to other atoms helps to shorten C–C and C = bond in polyatomic compounds as compared with C_2. The same effect is noted in N compounds. AUTHOR.

4594. Application of New Method of Analysis to Molecular Spectra. H. Deslandres. *Comptes Rendus*, 209. *pp*. 612–616, *Oct*. 23, 1939.—The spectra of PH_3, PD_3, H_2, HD, D_2, C_6H_6 and C_6D_6 are analysed by the method previously described [see Abstract 727 (1939)]. The arrangements of the types P-H_3, PH_2–H, H_4, H_8, H_{16}, C_3H_3–C_3H_3 and C_6H_5–H predominate for both H and D compounds. C. B. A.

4595. Spectrum of RbH. Parts I and II. A. G. Gaydon and R. W. B. Pearse. *Roy. Soc., Proc.* 173*A*. *pp*. 28–47, *Nov*. 10, 1939.—In Part I a band spectrum attributed to RbH, was observed in a discharge tube source containing metallic Rb and H_2. The spectrum was photographed on a 20 ft. concave grating spectrograph, and a rotational and vibrational analysis made. The spectrum is of the "many-line" type characteristic of the alkali-metal hydrides, and is produced by a $^1\Sigma \rightarrow {}^1\Sigma$ electronic transition. The band system is strongly degraded to longer wave-lengths, corresponding to a large change of the vibrational frequency; ω_e is 936·77 cm^{-1}. for the ground electronic state and 244·6 cm^{-1}. for the excited state. The constants associated with the vibration and rotation of the molecule were calculated for the ground and excited electronic states. The excited state shows anomalies similar to those observed for the other alkali-metal hydrides. In Part II the intensity distribution among the various vibrational transitions of the electronic emission spectrum of RbH is described; in addition to the normal Franck-Condon parabola, which in this case is very open, there are very well marked secondary and tertiary parabolæ. To account for these subsidiary parabolæ it is necessary to apply the methods of wave mechanics. As RbH is a particularly favourable example, an attempt was made to compare the observed intensity distribution with that expected theoretically. The potential functions were calculated from the molecular constants derived from the analysis of the spectrum, and the potential curves are drawn and discussed briefly. The wave functions for the various vibrational levels of a harmonic oscillator were calculated for the two electronic states, and these were distorted, by a simple method, to correspond approximately to the potential curves. Using these wave functions the intensity distribution was calculated. It is in good general agreement with the observations, but shows some discrepancies in detail. The various assumptions and approximations made in making the calculations are examined. It is concluded that such discrepancies as exist are probably to be attributed to the approximate method of distorting the wave functions of the harmonic oscillator to correspond to the potential curves. AUTHORS.

4596. Normal Vibrations and Configuration of Hydrazine. Part II. W. Fresenius and J. Karweil. *Zeits. f. phys. Chem.* 44. *Abt.B.* 1. *pp*. 1–13, 1939.—The infra-red spectrum of hydrazine has been measured from 3 to 14 μ. An assignment of the infra-red and Raman bands to one of the three possible molecular structures of N_2H_4 [see Abstract 4058 (1939)] is discussed, and it is shown that the spectra agree with Penney and Sutherland's asymmetric model. The computations of the specific heat from the normal vibrations agree with the measurements.

The torsional vibration of the two NH_2 groups against each other is found to be 749 cm^{-1}. corresponding to a potential of 6000 to 10000 cal. L. K.

4597. Polarisation of Raman Lines in Relation to Molecular Structure : $SOCl_2$, CH_3Cl and BCl_3. K. Venkateswarlu. *Indian Acad. Sci., Proc.* 10*A. pp.* 156–166, *Sept.*, 1939.—The polarisation characters of the six lines at 194, 283, 344, 439, 489 and 1231 contained in the Raman spectrum of $SOCl_2$ are determined. It is found that three of them (194, 283 and 439) are depolarised to the limit and the other three well polarised. Cabannes and Rousset [see Abstract 2446 (1933)] observed that the line at 194 was polarised. Their results indicate a pyramidal model to the $SOCl_2$ molecule but the values obtained by the author in the present investigation suggest that the $SOCl_2$ molecule has a plane structure. Cabannes and Rousset obtained six frequencies at 712, 1098, 1378, 1450, 2958 and 3024 for CH_3Cl out of which four were found to be polarised and the other two depolarised. Kohlrausch and Dadieu reported only five lines 712, 1357, 2815, 2955 and 3024. In all, the Raman spectrum of CH_3Cl contains 7 lines at 714, 1097, 1379, 1428, 2815, 2957 and 3028. The author has recorded the six lines obtained by Cabannes and Rousset. A study of the polarisation characters is also made. A discussion of the results shows that the line at 2957 is to be regarded as an overtone of the fundamental at 1428 and the six fundamental frequencies of CH_3Cl are 714, 1097, 1379, 1428, 2815 and 3028. The first three give rise to well polarised Raman lines and the other three give rise to depolarised Raman lines. It may be concluded that CH_3Cl is of pyramidal shape like $CHCl_3$. The overtone at 2957 is well polarised. Anderson, Lassettre and Yost [see Abstract 5575 (1936)] estimated visually the polarisation values of Raman lines at 253 and 471 in the Raman spectrum of BCl_3. The author has made a quantitative study and has obtained the values 0·8 and 0·3 respectively for these two lines. AUTHOR.

4598. Raman Effect in Relation to Crystal Structure. Part I. B. S. R. Rao. *Indian Acad. Sci., Proc.* 10*A. pp.* 167–175, *Sept.*, 1939.—A simple technique for obtaining clear and intense Raman spectra with small single crystals has been described. Spectrograms obtained with single crystals of $NaNO_3$ and $CaCO_3$ are reproduced. The frequency shifts, the intensity relations and the structural characters of the various Raman lines are given. The changes which the Raman frequencies undergo on passing from $NaNO_3$ crystal to the corresponding melt are enumerated and discussed. The first overtone of the forbidden fundamental is recorded and measured in all the cases. The positions of the lattice frequencies and their intensities are discussed in the light of what would be expected from a theoretical knowledge of the normal oscillations of the $NaNO_3$ and $CaCO_3$ lattices. AUTHOR.

4599. Effect of Crystal Orientation on Raman Spectrum of $NaNO_3$. T. M. K. Nedungadi. *Indian Acad. Sci., Proc.* 10*A. pp.* 197–210, *Sept.*, 1939.—The paper reports a detailed study and evaluation of 23 different spectrograms obtained with a single crystal of $NaNO_3$, corresponding to different orientations of the crystal relative to the directions of incidence and observation and different states of polarisation of the incident and scattered radiations. The most striking feature indicated by the spectrograms is the reciprocal behaviour of the two l.f. lines (98 and 185) as compared with the internal oscillations of the NO_3^- ion (720, 1065 and 1385)—the former appearing when the latter disappear, and vice versa—when the incident light is polarised and the scattered light is analysed.

It is found further that the two l.f. lines disappear in the longitudinal scattering of unpolarised light incident along the optic axis. These observations indicate that the oscillations giving rise to the l.f. lines are in the nature of a torsional movement or tilt of the NO_3^- ions in the crystal lattice, and confirm the theoretical deductions of Bhagavantam and Venkatarayudu. The strong birefringence of the crystal manifests itself in light scattering, being responsible for the fact that the internal oscillations appear more strongly when the incident light vector is in the plane of the NO_3 group than when it is perpendicular to the same. It is quite definitely established by the spectra that for the symmetric oscillation of the NO_3^- ion excited by light-vibrations in the plane of the ion, the moment induced does not coincide in direction with the incident light vector. This appears to indicate that the individual NO_3^- ion does not possess a trigonal symmetry in its own plane or, alternatively, that the incidence of a linear electric oscillation gives rise to an elliptic polarisation in the plane of the ion. AUTHOR.

4600. Raman Spectrum of HNO_3 Solutions in Ether and Chloroform. J. Desmaroux, J. Chédin and R. Dalmon. *Comptes Rendus*, 209. *pp*. 455–457, *Sept.* 11, 1939.—The Raman spectra of $(C_2H_5)_2O$ and of $CHCl_3$ are unaffected by the presence of HNO_3, whilst the low-frequency bands of the acid in solution in these substances are only slightly displaced; but the OH frequency at 3300 cm^{-1} in the spectra of pure HNO_3 and of its solution in $CHCl_3$ is completely absent in that of the ethereal solution. This phenomenon is attributed to the formation of an oxonium compound with the ether, and is correlated with the inability of the ethereal solutions to effect nitration. C. B. A.

***4601. Raman Spectra of Gases. Part I. Apparatus and Spectrum of Methylamine. J. S. Kirby-Smith and L. G. Bonner.** *J. Chem. Phys.* 7. *pp*. 880–883, *Oct.*, 1939.—An apparatus is described by means of which the Raman spectra of gases may be obtained at pressures as low as 2–3 atm. and with exposure times of 3–6 hr. The fundamentals of this apparatus are a high intensity light source, a large scattering volume and a large aperture spectrograph camera. Nine lines in the spectrum of methylamine have been measured and are compared with previous measurements on the liquid. An interesting feature of this spectrum is the existence of four lines in the region of C–H valence vibrations, where but two are expected. This anomaly is interpreted in terms of a double resonance interaction. AUTHORS.

***4602. Hydrogen Lamp. A. J. Allen and R. G. Franklin.** *J.O.S.A.* 29. *pp*. 453–455, *Oct.*, 1939.—A new type of hydrogen lamp is described suitable for studying the absorption of u.v. light by organic liquids in conjunction with a Hilger notched echelon cell. The lamp embodies a l.v. arc and employs an oxide-coated filament. A. H.

See also Abstracts **4426, 4526, 4565, 4653.**

TRANSMISSION.

4603. Comparison of the Velocity of Visual and Infra-Red Light by an Astronomical Method. J. S. Hall. *Frank. Inst., J.* 228. *pp*. 411–423, *Oct.*, 1939.—The visual and infra-red energy of the spectrum of Algol was measured by a photoelectric photometer and the time of minimum (due to the eclipse of one component of the binary by the other) was determined for each type of radiation. α-Persei was used as comparison star. A careful discussion of the observations, with particular emphasis on the need for differential correction for atmospheric extinction between the two wave-lengths, leads to the conclusion that the time of minimum is simultaneous in the visual and the infra-red. Hence it follows that the velocity of light of the two wave-lengths is the same. G. C. McV.

See also Abstract 4569.

X-RAYS.

4604. Splitting of Laue Spots. D. Gogoberidze. *J. Techn. Phys. U.S.S.R.* 9. 3. *pp.* 205–210, 1939. *In Russian.*—The author discusses, and illustrates by photographs, the effect of various factors, such as imperfections of the lattice and cracks, on the splitting of Laue spots from thick crystals D. S.

4605. Single Crystal X-Ray Diffraction Pattern of Calcite. F. Miller, Jr. *Phys. Rev.* 56. *pp.* 757–764, *Oct.* 15, 1939.—The method of analysis of double spectrometer rocking curves developed by L. P. Smith [see Abstract 4228 (1934)] is reconsidered. Although from Smith's very general viewpoint, six experimental curves are needed for a complete analysis, it is shown that for rocking curves from calcite, taken with the usual type of double spectrometer, it should be possible to deduce the shape of the single crystal diffraction pattern from two rocking curves, the (1, + 1) and (2, + 2). A method of modifying the equations of the instrument to allow for a simple type of mosaic structure is indicated. The equations have been applied to rocking curves of Mo Kα_1 from calcite, supplied by L. G. Parratt. The method requires resolution of the observed curves into Fourier components, and a numerical method of doing this is described. The reliability of the components obtained can be tested by predicting the (1, − 1) curve with them and comparing with experiment. In this way it is found that the curves are consistent as regards Fourier components of long period and large amplitude, but inconsistent in the short period, small amplitude components. A single crystal pattern is deduced, based mainly on the observed (1, − 1) curve, with asymmetry as indicated by the (1, + 1) and (2, + 2) curves. It indicates that the crystals used do not have the flat-topped Darwin-Ewald-Prins diffraction pattern. Possible causes of the short period discrepancy have been investigated, but an adequate explanation has not been found. AUTHOR.

4606. Identification of Characteristic X-Rays Associated with Radioactive Decay. P. H. Abelson. *Phys. Rev.* 56. *pp.* 753–757, *Oct.* 15, 1939.—An investigation has been made of the practicability of employing a bent rock-salt crystal spectrograph in the identification of X-rays emitted during radioactive decay. The spectrograph has been found to be a useable tool. X-rays associated with the disintegration of $_{31}Ga^{67}$ $_{29}Cu^{64}$, $_{35}Br^{80}$ and $_{43}Ma$ have been identified. AUTHOR.

4607. M$_1$ and M$_2$ X-Ray Absorption Edges of Lead. J. W. McGrath. *Phys. Rev.* 56. *pp.* 765–767, *Oct.* 15, 1939.—The M$_1$ and M$_2$ edges of lead, not having been previously measured, were investigated. They were found to occur at wave-lengths: M$_1$, 3·219 Å; M$_2$, 3·469 Å. A brief discussion of M edges is given and the fact that many M edges show discrepancies between observed and calculated values is noted. Methods of computing edge energies are discussed. The proposed explanation and meaning of these discrepancies are discussed with particular reference to lead. [**Erratum,** *ibid. p.* 1068, *Nov.* 15.] AUTHOR.

4608. Fine Structure of X-Ray Absorption Edges. Parts I and II. G. H. Klamer. *Ned. T. Natuurk.* 6. 13. *pp.* 225–233, *and* 6. 14. *pp.* 241–252, 1939.—A review is made on the experimental work of Coster and collaborators, and the theory of Kronig, on the fine structure of absorption edges in solids. The fine structure is due to the diffraction of the emitted electron by the crystal lattice. That of the absorption edges of molecules is due to the interference between the electron waves produced by the absorption process in the different atoms constituting the molecule. R. P.

***4609. Proportional Counter for Measurement of X-Ray Intensities. A. Bibergal, S. Matveev and V. Khruschev.** *J. Techn. Phys. U.S.S.R.* 9. 3. *pp.* 215–221, 1939. *In Russian.*—The authors show that a proportional counter can be used to measure X-ray intensities, and that it can be made more sensitive than an ionisation chamber. D. S.

See also Abstracts 4434, 4694.

HEAT.

CALORIMETRY.

4610. Latent Heats of Sublimation and Evaporation. W. Hume-Rothery. *Phil. Mag.* 28. *pp.* 465–480, *Oct.*, 1939.—It is shown that for many substances with relatively large heats of fusion, the values of the ratios of the latent heat of sublimation of the solid (λ_s) to the latent heat of evaporation of the liquid (λ_e) at the triple points tend to approximate to the ratios of small whole numbers, not exceeding 8. A similar relationship is also frequently found for the latent heats of the different modifications of substances which exist in different allotropic forms. As a tentative explanation, it is suggested that in the region of the triple point the liquid has a structure in which the atoms are held together by a definite number of bonds of the same nature as those concerned in the cohesion in a solid crystal, but differing in number. This agrees with the fact that for the majority of normal metals, for which λ_s/λ_e is nearly unity, the structure of a liquid metal at its melting point tends to resemble that of the solid. R. W. P.

See also Abstract 4620.

CONDUCTION.

4611. Thermal Conductivity of Technical Alloys at Low Temperatures. S. Zlunitzin and I. Saveljev. *J. Techn. Phys. U.S.S.R.* 9. 9. *pp.* 805–807, 1939. *In Russian.*—The thermal conductivities of a number of technical alloys were measured at 18, 78 and 290° K. and found to become much smaller at the lower temperatures. D. S.

***4612. Apparatus for Measuring Thermal Conductivity of Refractories. C. Codegone.** *Ricerca Scientifica,* 10. *pp.* 701–706, *July–Aug.*, 1939.—One end of a long cylindrical furnace is formed by four circular plates on top of each other. By placing thermocouples between two successive plates, the temperature gradients in two of the plates can be found. One of these two is the specimen under investigation, the other has a known heat conductivity. Radial temperature gradients are avoided by surrounding the discs with guard rings which contain heaters. These heaters are so adjusted that thermocouples inserted between the discs near their circumference show the same temperature as those in the centre. R. P.

See also Abstracts 4455, 4481, 4482.

CONVECTION.

4613. Influence of Free End of a Rod on Heat Transfer. M. Jakob. *Phil. Mag.* 28. *pp.* 571–578, *Nov.*, 1939.—Simple equations of temperature and heat transfer are derived for the case in which the coefficient of heat transfer can be considered as constant over the whole surface of a rod, tube, or fin, which is heated or cooled at one end. An application to a thermometric arrangement shows that neglecting the end influence may cause considerable mistakes in temperature measurement. AUTHOR.

DILATATION.

***4614. Sealing Platinum to Pyrex Glass. E. Wichers and C. P. Saylor.** *Rev. Sci. Instruments,* 10. *pp.* 245–250, *Sept.*, 1939.—This paper describes tests made on Housekeeper's method [see Abstract 101B (1924)] of obtaining a gas-tight seal of Pt through pyrex glass, by using the Pt in the form of a tube. The breaking apart of the two materials is due to the strains set up by their different expansions, but if the seal is made in this manner—two concentric tubes—their dimensions can be so arranged that this strain is not great enough to tear them apart. These dimensions are expressed as d, t_1 and t_2, the diameter at the boundary, the wall-thickness of the Pt and the wall-thickness of the glass. Some data are obtained as to values of these quantities which will give a good seal. The test for gas tightness is made by using a McLeod gauge, though examination for strains is also made microscopically by observing birefringence effects. The theory of this problem is also discussed. G. G.

See also Abstract 4513.

FUSION AND SOLIDIFICATION.

4615. Freezing-Point of Rhodium. C. R. Barber and F. H. Schofield. *Roy. Soc., Proc.* 173*A*. *pp.* 117–125, *Nov.* 10, 1939.—The freezing-point of Rh on the International Temperature Scale has been determined by measuring the ratio of brightness, for a certain wave-length, of black-body radiators held at the freezing-points of Rh and Au, the latter being the basic point of the scale for all high temperatures. The experimental procedure was similar to that adopted for determining the freezing-point of Pt [see Abstract 5123 (1934)] and the value obtained, 1966 ± 3° C., is indistinguishable from the only previous one by the same method, namely that of the National Bureau of Standards [see Abstract 2556 (1934)]. AUTHORS.

See also Abstracts 4630, 4669.

TEMPERATURE.

***4616. Instrument for the Reproduction, Regulation and Control of Variable Temperature. W. E. Stone.** *Washington Acad. Sci., J.* 29. *pp.* 410–415, *Oct.* 15, 1939.—An instrument has been developed to permit the laboratory reproduction of field-recorded temperatures in experiments at Mexico City to determine the possible range of distribution of the

Mexican fruitfly and related species in the United States. A description of the instrument showing the essential details of construction is given. The method of preparation of the chart patterns, showing the different steps in the operation and the time consumed, and the methods of making adjustments and of operation are discussed. A mercury-toluene thermostat made of 50 in. 6/16-in. bore tubing with a neck of 3/16-in. bore tubing has been used with the instrument intermittently for 3 years without apparent change in volume. Standard well-insulated temperature cabinets cannot be used with the instrument when producing or reproducing highly variable temperatures unless they are equipped with cooling coils, because cooling is too slow. The accuracy obtained in operation is shown in a photograph of charts of reproductions of daily and weekly temperature records and of the production of a gradually increasing and decreasing temperature as well as a constant temperature. AUTHOR.

***4617. Thermostat for Photographic Solutions. P. A. Bishop and G. E. Bierce.** *Am. J. of Roentgenology and Radium Therapy,* 42. *pp.* 141–142, *July,* 1939.—A device is described for maintaining X-ray film developing solutions at a constant temperature of 65° F. It depends on the use of a thermometer having three electrical contacts, one in the lower mercury column and the other two at 63° F. and 65° F. Should the solution temperature fall to 63° F., hot water is supplied by means of a solenoid device, to a water bath surrounding the developing solutions. When the temperature reaches or exceeds 65° F. a similar solenoid device supplies cold water to the surrounding bath. B. J. L.

***4618. Low-Temperature Thermostat. R. P. Bell and J. K. Thomas.** *Chem. Soc., J. pp.* 1573–1575, *Oct.,* 1939.—A simple low-temperature thermostat is described, and details are given for its operation between 10° and − 40°. AUTHORS.

See also Abstracts 4611, 4623, and

2510B. Vacuum Thermocouples of the Radiation Type. S. S. Stack.
2734B. Temperature Regulation. S. L. Barron.

THERMOCHEMISTRY.

4619. Heat of Combustion of *cis*- and *trans*-Azobenzene. R. J. Corruccini and E. C. Gilbert. *Am. Chem. Soc., J.* 61. *pp.* 2925–2927, *Oct.,* 1939.—The isothermal heat of combustion of *cis*- and of *trans*-azobenzene is determined for 25° and constant pressure. The heats of formation and of transition are calculated. AUTHORS.

***4620. Heats of Formation of Hydrazine and of Hydrazine Hydrate. A. M. Hughes, R. J. Corruccini and E. C. Gilbert.** *Am. Chem. Soc., J.* 61. *pp.* 2639–2642, *Oct.,* 1939.—An adiabatic calorimeter for precise determinations of heats of combustion is described briefly along with its calibration. Heats of combustion for hydrazine and hydrazine hydrate are determined. The standard heat of formation of hydrazine, liquid and gas; hydrazine hydrate, liquid and aqueous; and the heat of hydration of anhydrous hydrazine are calculated. AUTHORS.

4621. Assignment of Uncertainties to the Data of Chemistry and Physics, with Specific Recommendations for Thermochemistry. F. D. Rossini and W. E. Deming. *Washington Acad. Sci., J.* 29. *pp.* 416–441, *Oct.* 15, 1939.—In order that the results of measurements made in different laboratories may be compared and appraised for the purpose of estimating the uncertainty or confidence interval to be attached to the published value of a physical or chemical constant, it is desirable that experimenters adopt a uniform procedure for expressing the consistency of their data, or be explicit in their statements regarding such consistency. The purpose of this paper is to present some discussion on this subject and to offer some specific recommendations in connection with the experimental data of thermochemistry. Notes are included on the theory of probability which deal with single sample and pair of samples or sets of observations and also with functional concordance. Propagation and combination of errors are then considered with application to measurements in general. Among the specific recommendations for thermochemistry is a procedure for combining standard deviations with a discussion of it and of the uncertainty interval. A Bibliography of 12 standard references completes a useful mathematical publication. H. H. Ho.

THERMODYNAMICS.

4622. Relativistic Thermodynamics and Gas Theory. D. van Dantzig. *K. Ned. Akad. Wet., Proc.* 42. 7. *pp.* 601–625, 1939.—Relativistic thermodynamics is developed, somewhat further than has been done by Einstein, Planck, Tolman and others, by the application of tensor-analysis, and the same method is applied to relativistic gas theory. The main difference between the present paper and older ones consists of the symmetrical treatment of the time-coordinate compared with other coordinates. By extending integrals over the interior only of the characteristic surface it is shown that only one integral, *viz.*, that presenting the pressure, need be computed directly as all other thermodynamic quantities can be derived from it. The controversial question of the relation between proper particle-density and proper energy-density is discussed; the correct value of the former for an ideal gas is intermediate between Schwarzschild's and Eddington's values, but is, in general, independent of the stress-tensor. J. S. G. T.

4623. Bose-Einstein Condensation. T. Nagamiya. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 475–485, *Aug.*, 1939. *In English.*—The anomalous property of a Bose-Einstein ideal gas at low temperatures, *i.e.*, an anomalous condensation, has already been discussed by Einstein and other writers (London, Fowler and Jones), and it is the object of this paper to extend the problem to general Bose-Einstein assemblies of independent particles. The meaning of this condensation has now been clarified, and general formulæ relating the energy, specific heat, free energy and pressure are discussed. The applicability of the "pure" Bose-Einstein assembly to liquid He is considered, and the difficulty of interpretation recognised, especially the view of London that He atoms are divided into two classes with a definite ratio, *viz.*, a part consisting of those atoms which construct a crystal lattice and contribute to the specific heat (the Debye T^3-term) and the other a Bose-Einsein assembly contributing its characteristic discontinuity. The author finds that such a division seems artificial. H. H. Ho.

4624. Hole Theory of Condensation. J. G. Kirkwood. *J. Chem. Phys.* 7. *pp.* 908–911, *Oct.*, 1939.—The hole theory of condensation recently proposed by Cernuschi and Eyring [see Abstract 3376 (1939)] is discussed from the standpoint of the order-disorder theory of critical solution phenomena. It is pointed out that the hole theory predicts critical temperatures which are several times larger than those observed for most nonpolar fluids. This is attributed to the failure of the theory to take adequate account of the lattice vibrational factor in the partition function. AUTHOR.

4625. Dissociation Treatment of Condensing Systems. Part II. W. Band. *J. Chem. Phys.* 7. *pp.* 927–931, *Oct.*, 1939.—In Part I [see Abstract 2950 (1939)] it was shown how the theory of dissociating assemblies could be applied to an example containing only one component type of molecule which can form clusters of any size. The results were claimed as equivalent with those of Mayer [see Abstract 520 (1937)]. In a private communication Mayer has pointed out to the writer that this claim is only approximately correct, because the clusters were treated as of negligible size, excluded volumes being ignored. It is therefore necessary to regard Part I as giving a "perfect gas analogy" for the theory of the saturated vapour pressure curves at temperatures well below the critical value. The present paper develops the more accurate theory by taking into account the excluded volumes and, besides the *s-v-p* curves, also presents a complete set of equations for the isothermals of the gas and vapour right through the critical temperature. AUTHOR.

4626. P.V.T. Relations of Ethylene in the Critical Region. Parts I and II. J. Dacey, R. McIntosh and O. Maass. *Canad. J. of Research,* 17. *Sect. B. pp.* 206–213, *July, and pp.* 241–250, *Sept.*, 1939.—Pressure isothermals of the system were determined both above and below the temperature of disappearance of the meniscus. Regions of constant pressure with changing volume were observed with all isothermals, in agreement with the prediction of Mayer and Harrison. The complete envelope of this region above the critical temperature has not as yet been determined. The pressure of the heterogeneous system at 9·50° C. was found to correspond within experimental error to the pressure of the flat portion of the homogeneous isothermal at the same temperature. The pressure of this heterogeneous system was found to be independent of the mass-volume ratio; this is in agreement with the experimental behaviour previously discovered by the authors for such a system at 9·80° C. Moreover, the pressure of the heterogeneous system was found to be identical with that of the system which had been heated at constant volume to a temperature at which the density difference in the tube is known to have been destroyed, and then cooled to the same temperature of 9·50° C. The isothermal at 9·60° C. was studied, and shown to be the equilibrium curve at that temperature. A hysteresis was observed on reversing the direction of measurement, *i.e.*, from "vapour" to compressed "liquid". This hysteresis was found to be caused by the time lags which are observed in passing from the "vapour" region of an isothermal to regions of high density. Certain apparent discrepancies between the work of the present authors and that of Geddes and Maass have been observed and cannot as yet be explained. The phenomena observed are interpreted on the basis of a difference between the gaseous and liquid states of aggregation, with a structure assigned to the latter. In Part II the data are extended. Nine pressure isothermals of the one component system ethylene in the critical region are given. Further evidence of the existence of a two-phase system above the temperature of meniscus disappearance as normally determined is presented. The existence of a latent heat of vaporisation above this temperature is pointed out. An explanation of the hysteresis of liquid phase density with temperature at constant volume is offered, and a qualitative description of

the changes occurring in the transition region of liquid to gas is developed from the experimental evidence. [See also Abstract 4091 (1939).]
AUTHORS.

4627. P.V.T. Relations in Solutions. Part III. Thermodynamic Properties of Mixtures of Aniline and Nitrobenzene. R. E. Gibson and O. H. Loeffler. *Am. Chem. Soc., J.* 61. *pp.* 2877–2884, *Oct.*, 1939. [For Part II see Abstract 4359 (1939).]

4628. Raoult's Law and the Clapeyron Equation for Substances whose Vapours are Polymerised. J. H. Simons and A. S. Russell. *J. Phys. Chem.* 43. *pp.* 901–907, *Oct.*, 1939.—Raoult's law and the Clapeyron equation have been considered for the case where the vapour of the substance consists of a monomer and any number of polymers. Raoult's law is shown to be independent of the nature of the liquid and to depend upon the determined apparent molecular weight of the vapour. It is simple in form and can be readily applied to equations for boiling-point rise, etc. An explanation is given for the relatively straight line obtained when the logarithm of the vapour pressure is plotted against the reciprocal of the absolute temperature for substances such as acetic acid and HF.
AUTHORS.

4629. Specific Heat and Double Minimum Problem of NH_3. R. F. Haupt and E. Teller. *J. Chem. Phys.* 7. *pp.* 925–927, *Oct.*, 1939.—The specific heat of ammonia is calculated in the temperature range from 0° C. to 150° C. The effect of the anharmonicity of the 948 cm.$^{-1}$ vibration on the specific heat is very noticeable. Small corrections due to the stretching of the molecule by centrifugal force and the interaction of vibration and rotation are taken into account. The results are in good agreement with measurements of Osborne, Stimson, Sligh and Cragoe [see Abstract 1688 (1925)].
AUTHORS.

4630. Nature of Fusion Process in Argon. O. K. Rice. *J. Chem. Phys.* 7. *pp.* 883–892, *Oct.*, 1939.—A brief review is presented of the method previously used of treating the phenomenon of fusion by means of curves for the thermodynamic functions $(\partial E/\partial V)_T$ and $(\partial S/\partial V)_T$ as functions of the molal volume. The curves used by the writer in previous work are shown to be consistent with Bridgman's P.V.T. data. The characteristics of these curves are discussed, and the evidence is considered which tends to indicate that fusion involves an order-disorder phenomenon. The applicability of various types of order-disorder theory is critically considered in the light of the available experimental data. [See Abstracts 3781 and 3783 (1938).]
AUTHOR.

4631. Thermodynamics of Hydrogen Cyanide. W. F. Giauque and R. A. Ruehrwein. *Am. Chem. Soc., J.* 61. *pp.* 2626–2633, *Oct.*, 1939.—The heat capacity of solid and liquid HCN has been measured from 14° to 300° K. The melting and boiling points were found to be 259·86 and 298·80° K., respectively (0° C. = 273·10° K.). The heat of fusion is 2009 cal. mole^{-1}. An energy absorption of 3·8 cal. mole^{-1} occurred over a small temperature range with a maximum at 170·37° K. The heat of vaporisation at the boiling point was determined calorimetrically to be 6027 cal. mole^{-1}. The vapour pressure of liquid HCN was measured and the data are represented by the equation for liquid HCN, $\log_{10}P$ (inter. cm. Hg) $= -(1600\cdot 8/T) - 0\cdot 0017835\,T + 7\cdot 77114$, from 259·86 to 298·9° K. The triple point pressure is 14·040 inter.cm. Hg. The available gas density data on HCN have been used to show that multiple polymerisation exists. The data are taken to indicate indefinite straight chain hydrogen bond polymerisation in the gas, as suggested by Kumler for the liquid, in explanation of its abnormally high dielectric constant. The fraction of the gas in the various polymeric forms up to the heptamer has been calculated. It has been estimated that hydrogen bond polymerisation occurs in saturated water vapour to the extent of 3 % at the boiling point. The data and the third law of thermodynamics were used to calculate the entropy of monomeric HCN gas at 298·10° K. and 1 atm. The experimental value 47·92 cal. deg.$^{-1}$ mole^{-1}, which contains a small possible error on account of uncertainty in the temperature coefficients of the polymerisation reactions, is in agreement with the value 48·23 cal. deg.$^{-1}$ mole^{-1}, calculated from the band spectrum data. The entropy of liquid HCN at 298·1° K. is 26·97 ± 0·05 cal. deg.$^{-1}$ mole^{-1}. AUTHORS.

4632. Thermodynamic Data of Cyanogen. R. A. Ruehrwein and W. F. Giauque. *Am. Chem. Soc., J.* 61. *pp.* 2940–2943, *Oct.*, 1939. —The heat capacity of solid and liquid $(CN)_2$ was measured from 15° K. to the boiling point. The melting and boiling point temperatures were found to be 245·27 and 251·95° K., respectively (0° C. = 273·10° K.). The heats of fusion and vaporisation were determined by calorimetric observation to be 1938 and 5576 cal. mole^{-1}, respectively. The vapour pressure of solid and liquid was measured and the data are represented by equations (given in the original). The calorimetric data were used to calculate the entropy of cyanogen gas and this value has been compared with one obtained from molecular data and it is found that the entropy of cyanogen approaches zero near the absolute zero of temperature. Until more complete information concerning the vibrations of the cyanogen gas molecule is available the most reliable value of the entropy of cyanogen is the calorimetric one, 57·4 cal. deg.$^{-1}$ mole^{-1} at 298·1° K. and 1 atm. This value does not include the nuclear spin entropy. AUTHORS.

See also Abstracts 4468, 4478, 4485, 4583, 4669.

VAPORISATION AND CONDENSATION.

4633. Binary Liquid Systems. Part I. Vapour-Liquid Equilibria in the System Carbon Tetrachloride-Ethyl Acetate. P. W. Schutz. *Am. Chem. Soc., J.* 61. *pp.* 2691–2693, *Oct.*, 1939.—The system carbon tetrachloride-ethyl acetate has been investigated at 685 mm. and found to behave as expected for a system having a minimum boiling mixture, contrary to indications from other data. AUTHOR.

4634. Vapour Pressure of Tri-*m*-Cresyl Phosphate over Polyvinyl Chloride Plastics. F. H. Verhoek and A. L. Marshall. *Am. Chem. Soc., J.* 61. *pp.* 2737–2742, *Oct.*, 1939.—The vapour pressures of tri-*m*-cresyl phosphate, tri-*p*-cresyl phosphate, dibutyl phthalate and dibenzyl sebacate in the neighbourhood of 100° have been measured by a static and by dynamic methods. The accommodation coefficients for these liquids are unity. The vapour pressure of the plasticiser in a polyvinyl chloride-tri-*m*-cresyl-phosphate plastic containing at least 15 % of the latter appears to be equal to the vapour pressure of the pure plasticiser and is independent of the composition of the plastic. AUTHORS.

See also Abstracts 4476, 4477, 4478, 4479.

ACOUSTICS.

4635. Frequency Produced by the Combination of Two Vibrations of Nearly Equal Frequency. G. E. Owen. *Am. Phys. Teacher,* 7. *pp.* 177–178, *June,* 1939.—Analysis of the resultant vibration due to two vibrations $y_1 = A \sin pt$ and $y_2 = a \sin (qt + \delta)$, where $p-q$ is small compared to p or q, shows that in general the resultant has no definite frequency; its frequency varies with time and also depends on the values of A and a. When the amplitude of the beat frequency is near its maximum the frequency is found to be $(pA + qa)/2\pi(A + a)$, which for equal amplitudes becomes the arithmetic mean of the component frequencies. When the amplitude of the beats is near its minimum and A is appreciably greater or less than a, the frequency is $(pA - qa)/2\pi(A - a)$, which may be greater than that of either component. Measurements made on an oscillogram of the beat tone between two frequencies of 2304 and 2048 ∼ show a frequency of 2200 at the amplitude maximum and 2600 ∼ at the amplitude minimum. Calculation from the known amplitudes gives the same values within the limits of the measurements. One result of this fluctuation of frequency is that most oscillograms of beats show sharp lines at the maxima and blurred ones at the minima, since the sweep circuit, if in synchronism at the maxima, is out of synchronism at the minima.
A. W.

4636. Resonant Radial Frequencies of a Cylinder of any Wall Thickness. G. S. Field. *Canad. J. of Research,* 17. *Sect. A. pp.* 141–147, *July,* 1939.—Equations have been derived for the resonant radial frequencies of a cylinder of any wall thickness. For the degenerate case of the internal radius equal to zero, the equations are shown to reduce to those previously given for a solid rod [see Abstract 5148 (1934)]. For a cylinder with a very thin wall, the frequency equation becomes very simple. but contains an additional factor compared with the equation usually given for a thin-walled cylinder. It is suggested that the two cases correspond to slightly different types of vibration, and that the one considered in this paper is physically more likely. AUTHOR.

***4637. Filtration of Sound. Part II. R. B. Lindsay.** *J. of Applied Physics,* 10. *pp.* 680–687, *Oct.,* 1939.—The filtration structures considered in Part I [see Abstract 5005 (1938)] employed some gas as the propagation medium. The general theory is, however, of such a character that it should apply to elastic waves in any material medium containing periodic discontinuities or non-homogeneities of structure. The present paper deals with solid structures, a typical example being a solid rod loaded at equal intervals with heavy masses. This is shown to be a low-pass compressional wave filter whose theoretical cut-off frequency is in good agreement with experimental measurement by Olson. Various types of high-pass filters are suggested, the most promsing of these consisting of a central rod inside a cylinder, with uniformly stretched membranes connecting the two at regular intervals. Such a structure will also act as a high-pass torsional wave filter. The properties of stratified media and of dissipative structures are also discussed.
A. W.

4638. Filtration of Oblique Elastic Waves in Stratified Media. R. B. Lindsay. *Acoustical Soc. of America, J.* 10. *pp.* 178–183, *Oct.,* 1939.—Previous work has been done [see Abstract 1246 (1934)] on the problem of the transmission of plane compressional elastic waves normally through a stratified medium consisting of alternate plane parallel layers of two different substances. Such a structure acts as a low-pass elastic wave filter. The present paper extends the analysis to the case of oblique transmission. This proves to be comparatively simple when the layer substances are both fluid. The transmission and attenuation (i.e. reflection) bands are found to depend on the angle of obliquity in a characteristic way. When one of the layer substances is solid, the problem is more difficult. Account must here be taken of the fact that compressional waves in the fluid layers give rise to both dilatational and shear waves in the solid layers. The result is somewhat more complicated than in the previous case but the structure still turns out to be a low-pass elastic wave filter for angles of obliquity less than the critical angle. As before the transmission and reflection bands are a function of the angle. In the special case in which the thickness of the solid layers is small compared with that of the fluid layers one obtains the elastic wave analogue of the Bragg reflection law for X-rays, that is, one gets reflection approximately for the wave-lengths $\lambda_n = 2l/n \cdot \sin\theta$, where l is the distance between successive solid layers and n is integral. AUTHOR.

4639. Effect of Rotatory and Lateral Inertia on Flexural Vibration of Prismatic Bars. W. T. Thomson. *Acoustical Soc. of America, J.* 11. *pp.* 198–204, *Oct.*, 1939.—The problem of the flexural vibration of prismatic bars neglecting the rotatory and lateral inertia is treated in various texts on sound and vibrations. The effect of neglecting these two terms introduces no appreciable error when the cross-section of the bar is small in comparison to its length. For bars of large cross-section the error introduced in neglecting these terms is sufficient to warrant attention. In his text on sound Rayleigh offers an approximate solution introducing a correction term for the rotatory inertia, under certain boundary conditions. In a more recent paper Mason gives an exact solution for the frequency of vibration, where the rotatory and lateral inertia are taken into account [see Abstract 2313 (1935)]. The disadvantage of this solution lies in the fact that his equation for the eigenvalues of the frequency is extremely complicated, thereby throwing up a barrier to further analysis. No mention is made by previous investigators of the effect of the rotatory and lateral inertia on the node positions or the shape of the deflection curve. It is the purpose of this paper to present a simplified exact solution and to determine the effect of the two terms mentioned on the position of the nodes and the relative amplitude of vibration. Curves applicable to the solution of any type of constant cross-section are included. AUTHOR.

4640. Theory of Excitation of Pianoforte Strings. N. Jakovlev. *J. Techn. Phys. U.S.S.R.* 9. 4. *pp.* 321–328, 1939. *In Russian.*—An approximate theory is given of the excitation of a pianoforte string. The condition is obtained for the hammer to leave the string before the reflected wave from one end of the string returns to the point of impact. This condition is fulfilled only for the first 5 bass strings of the piano examined. [See Abstracts 1825 (1927) and 149 (1928).] D. S.

4641. Propagation of Shock Waves in Air. Part I. L. Thompson and N. Riffolt. Part II. L. Thompson. *Acoustical Soc. of America, J.* 11. *pp.* 233–254, *Oct.*, 1939.—From a consideration of conditions at the boundary of a source of shock in air, and of conditions at great distances, a formula of the Riemann type has been derived for the velocity of propagation of a finite pulse. The formula includes an additional constant which provides the necessary flexibility to represent data obtained throughout the fields of sources consisting of detonating charges of explosives, and of other sources. The observations of wave displacements have been summarised in terms of an integral for " reduced " times, from which the constants of the function for velocity are immediately available. All distances are defined with reference to an equivalent dimension of the source, and the characteristics throughout the velocity field are obtainable from the characteristics of the source. A table is given for the velocity of a condensation pulse, for representative boundary velocities, at various distances from the source out to points at which the velocity has decreased approximately to its asymptotic value (the normal velocity of sound). Results obtained by Wolff and Burlot for very large sources are shown for comparison on a plot of reduced times. Preliminary results obtained with piezo-gauges of experiments to determine relative pressures at the head of the wave are given in comparison with theoretical gauge pressures. In Part II, using the Rankine-Hugoniot equation of condition and Hugoniot's velocity of a discontinuity in a gas, formulæ are obtained for density and pressure at the head of a shock wave which are referred to velocity of the wave as a parameter. Gauge pressures are defined in a form considered to represent the observations of pressure obtained in Part I. The function is used to calibrate the gauge, and a comparison of results by Rayleigh's pressure function is included. A discussion is given of the appropriate ratio of specific heats for condensation cycles so extremely short in duration as those of intense shock waves, with references to the literature bearing on the subject of the accumulation of molecular excitational energies in short intervals of time. AUTHORS.

4642. Sonoluminescence and Sonic Chemiluminescence. E. N. Harvey. *Am. Chem. Soc., J.* 61. *pp.* 2392–2398, *Sept.*, 1939.—The fact that the sonoluminescence of pure water and Br_2 water occur in N_2 but not in H_2 is strong evidence for the view that the light is not the result of oxidation but is connected with the development of balloelectric potentials, since these are known to be large in N_2 and small in H_2. The occurrence of luminescence in pure N_2 shows definitely that activation of dissolved N_2 is not involved. No facts are directly opposed to the balloelectric discharge theory of sonoluminescence. The minute bubbles of cavitated gas are pictured as developing a considerable electrical charge, and when they collapse their capacity decreases and their voltage rises until a discharge takes place in the gas of the bubble, giving rise to a weak luminescence. The discharge may be thought of as occurring near the instant of complete collapse. Since velocity of bubble collapse is favoured by slightly increased hydrostatic pressures, the sonoluminescence is likewise increased under slight pressures. If O_2 is present in the fluid, the discharge leads to activation, with formation of H_2O_2 or direct chemical reaction of activated O_2 with certain compounds present in solution such as aminophthalichydrazide, and chemiluminescence then results. Sonoluminescence is remarkably independent of substances dissolved in the water phase but is quenched by the high vapour pressure of water (from rise of temperature) or by specific volatile organic compounds. H. H. Ho.

4643. Visible Stationary Supersonic Waves in Liquids. O. Nomoto. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 495–496, *Aug.*, 1939. *In German.*—A short note on a previous paper [see Abstract 3682 (1937)]. A table is given of the intensity distribution in the diffraction bands when progressive supersonic waves are illuminated stroboscopically. The table represents also the intensity distribution for the case of a stationary wave with stroboscopic illumination. By derivation from the data contained in the table it is shown that the distribution of intensity in the bands for stationary waves agrees with the results given in the paper mentioned above. G. E. A.

4644. Supersonic Dispersion and Selective Absorption in Fluids Contained in Tubes. G. S. Field. *Canad. J. of Research,* 17. *Sect. A. pp.* 197–201, *Oct.,* 1939.—A consideration of the transmission of longitudinal sound waves down a fluid-filled tube indicates that anomalous dispersion of the wave may or may not occur at the frequency of radial resonance of the liquid column. In this paper it is shown that the criterion is the rigidity of the tube wall, as radial vibrations will ordinarily appear under the influence of a longitudinal sound wave only when the wall is able to respond appreciably to the alternating pressure occurring in the fluid. [See Abstract 2511 (1932).] AUTHOR.

4645. Velocity of Supersonic Waves in Liquid Argon. H. W. Liepmann. *Helv. Phys. Acta,* 12. 5. *pp.* 421–442, 1939. *In German.*—The velocity of supersonic waves in liquid argon is measured between the triple and normal boiling points, and is an almost linear function of the temperature. The method was substantially the same as used for liquid oxygen [see Abstract 4185 (1938)]. The velocity of sound in A was 842 m./sec. at − 186·5° C. and 867 m./sec. at − 189·5° C. with a quartz frequency of 7508·8 kc./sec. Measurement of the velocity in liquid N_2 gave 868 m./sec. at − 197° C. and 929 m./sec. at − 203° C. Values are also given for A-N_2 mixtures. The adiabatic and isothermal compressibilities and ratio of the specific heats are calculated and compared with the static measurements of other authors. G. E. A.

4646. Normal Modes of Vibration in Room Acoustics : Experimental Investigations in Nonrectangular Enclosures. R. H. Bolt. *Acoustical Soc. of America, J.* 11. *pp.* 184–197, *Oct.,* 1939.—Existing theories of room acoustics have long been recognised as incomplete. The inadequacy is particularly disturbing in the lack of agreement between absorption coefficients measured in different laboratories. The acoustic behaviour of small rooms cannot always be prescribed with certainty. Several investigators have shown the necessity of analysing a room as an assemblage of normal modes of vibration in a three-dimensional continuum. The present paper reports preliminary studies of one aspect of the " wave " approach : the influence of boundary shape on normal modes of vibration. An experimental method reported previously has been improved and further developed for exploring the distribution of sound in small reflective enclosures of various shape. Standing wave patterns have been plotted for the lowest four or five modes of vibration in each of three models : a parallelogram in plan, a trapezoid in plan, and a model with an " alcove " or coupled space. A number of normal frequencies have been measured in each model, and the nature of the frequency distributions has been studied. The results have been summarised with respect to their significance for room acoustics. In particular, it appears that rooms of irregular shape still possess discrete normal modes and standing wave patterns as pronounced as those which occur in simple shapes. [See Abstracts 1749 and 3738 (1939).] AUTHOR.

4647. Sound-Insulation Characteristics for Ideal Partitions. K. C. Morrical. *Acoustical Soc. of America, J.* 11. *pp.* 211–215, *Oct.,* 1939.—The present method of evaluating the effectiveness of sound insulative structures on the basis of mean values of transmission loss is inaccurate and unscientific in that it does not predict the performance of the unit in practice. In actual practice interest lies primarily in what loudness level will result in the insulated room rather than in any physical characteristics of the partition. The transmission characteristic of "ideal" partitions, or partitions which reduce the incident sound to a uniform loudness level, has been derived from a consideration of the intensity and frequency distribution of typically encountered speech and music and of the mechanism of hearing, and it has been shown that a family of these characteristics can be used as a means of predicting the insulation furnished by a particular structure and its manner of failure. The manner of extension of this method to ascertain the merit of a partition for different types of sounds is given. It is suggested that a further study of the subject be undertaken toward the end of specifying certain procedure to follow and methods to use in evaluating the performance of partitions. AUTHOR.

4648. Absorption of Sound at Solid Boundaries. B. Konstantinov. *J. Techn. Phys. U.S.S.R.* 9. 3. *pp.* 226–238, 1939.—The author calculates the absorption of sound at a plane solid boundary, taking into account the thermal conductivity and viscosity of the medium by means of Kirchhoff's classical results. D. S.

4649. Remaking Speech. H. Dudley. *Acoustical Soc. of America, J.* 11. *pp.* 169–177, *Oct.*, 1939.—Speech has been remade automatically from a buzzer-like tone and a hiss-like noise corresponding to the cord-tone and the breath-tone of normal speech. Control of pitch and spectrum obtained from a talker's speech are applied to make the synthetic speech copy the original speech sufficiently for good intelligibility although the currents used in such controls contain only low syllabic frequencies of the order of 10 ∼ as contrasted with frequencies of 100 to 3000 ∼ in the remade speech. The isolation of these speech-defining signals of pitch and spectrum makes it possible to reconstruct the speech to a wide variety of specifications. Striking demonstrations upon altering the pitch of the remade speech stress the contribution of the pitch to the emotional content of speech. Similarly the spectrum is shown to contribute most of the intelligibility to the speech. AUTHOR.

***4650. Acoustic Meter. V. Fedorovich and S. Saltikov.** *J. Techn. Phys. U.S.S.R.* 9. 8. *pp.* 737–742, 1939.—An acoustic meter is described with an even response from 50 to 6000 ∼. The sensitivity is of order 2 mV/bar and amplitudes between 0·35 and 1000 bars can be measured. D. S.

4651. Transmission of Sound Inside Pipes. P. M. Morse. *Acoustical Soc. of America, J.* 11. *pp.* 205–210, *Oct.*, 1939.—Methods developed in a previous paper [see Abstract 3738 (1939)] are used to obtain an exact solution for the transmission of sound inside a rectangular pipe with absorbing material on its inner walls. Plots are given whereby it is possible to determine the phase velocity and attenuation of the simpler type waves in terms of the specific acoustic impedance of the walls and the frequency of the wave. Several examples are given of the effect of the absorbing surfaces on the distribution of the sound pressure amplitude over a plane perpendicular to the axis of the pipe. The effect of the reactive part of the material's acoustic impedance on the attenuation of the sound is also discussed. Formulæ are developed for the transmission of sound in tubes of circular cross-section. The plots for rectangular pipes can also be used in calculations of the acoustical properties of rectangular rooms. AUTHOR.

***4652. Design for Keyboard Instrument in Just Intonation. C. Williamson.** *Acoustical Soc. of America,* J. **11.** *pp.* 216–218, *Oct.,* **1939.**—In a keyboard instrument, the just scale may be closely approximated by setting up two equally tempered scales, one on the basis of A440·0, the other on the basis of A436·3, and mechanically selecting from them those frequencies which most nearly satisfy the appropriate ratios. Within one octave above middle C, no scale-step is in error by more than 0·6 vibration per sec. The keyboard is exactly the same as that now used, and the instrument is playable in equal temperament when the performer so desires. AUTHOR.

See also Abstract 4573 and

2791B. An Efficient Piezoelectric Oscillator. W. W. Salisbury and C. W. Porter.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

4653. Electric Glow between Carbon Electrodes. F. H. Newman. *Phil. Mag.* 28. *pp.* 544–547, *Nov.,* **1939.**—In previous work [see Abstract 835 (1937)] with graphite electrodes at low pressure the radiation from the glow discharge was due to the ionised residual gases, there being no thermionic effect at the electrodes. Further experiments on this type of glow are described. Specially pure electrodes were used, since it was found that the presence of impurities on the cathode facilitates the striking of high-vacuum arcs. Observations were confined to the first few seconds after the glow discharge, which tends to fill the whole of the space surrounding the ends of the electrodes, had been started. Photographs show that the glow gives little continuous spectrum, but the Swan bands of C are prominent, particularly those at λ4381, 4737, 5165 and 5635, and the CN and CH bands are very marked. On the other hand, the Ångstrom bands of CO are faint. Comparison with observations of the spectra obtained when an electrical discharge was sent through the discharge tube indicates that the excitation potential of the Ångstrom bands is higher than that for the Swan, CN and CH bands. A. W.

See also Abstracts 4535, 4609, and

2513B. Experimental Study of Point Discharges. S. Yadoff.

CONDUCTION IN SOLIDS AND LIQUIDS.

4654. Electronic Energy Bands in Metallic Tungsten. M. F. Manning and M. I. Chodorow. *Phys. Rev.* 56. *pp.* 787–798, *Oct.* 15, **1939.**—Calculations of the electronic energy bands in metallic W are carried out by the Wigner-Seitz-Slater method. All numerical integrations were carried out on the M. I. T. differential analyser. It is found that the *d* band is broken up into five sub-bands. Some of these *d* bands are found to be about 15 eV in width. One is about 2 eV in width. The occupied energy range extends about 5 eV. The *s* band starts at a higher energy than the *d* bands and is occupied by much less than one electron per atom at the equilibrium interatomic distance. From the results of a previous paper, curves of E *vs*·k are plotted for the principal directions of propagation. From these, curves of the number of energy levels per unit energy range were determined by numerical and graphical methods which are described in an appendix. It is assumed that the n(E) curve for Ta is not greatly different from that for W except that there is one less electron per atom. From the n(E) curves the electronic contribution to the specific heat is calculated for the two metals and the results found to be in good agreement with the excess specific heat at high temperatures for both metals. The computed value does not agree with low temperature data on Ta. There are no low temperature data for W. Qualitative discussions of the differences in electrical resistance, temperature coefficient of resistance, and thermoelectric power of the two metals are given. The contribution of exchange effects to the paramagnetic susceptibility is treated by a rough model and it is shown that the assumption of the same value of the exchange integral for both metals gives satisfactory agreement with observed data. AUTHORS.

✱**4655. Magnet Current Stabiliser. J. L. Lawson and A. W. Tyler.** *Rev. Sci. Instruments,* 10. *pp.* 304–307, *Oct.,* 1939.—A precision current stabiliser is described which is suitable for controlling an electromagnet. The circuit is adaptable to a wide range of current values. Applications to a cyclotron and to a β-ray spectrometer are discussed. Currents have been stabilised over a period of several hours to better than 1 part in 50000. AUTHORS.

✱**4656. Two-Stage Voltage Stabiliser. T. P. Gill.** *Journ. Sci. Instruments,* 16. *pp.* 345–347, *Nov.,* 1939.—A voltage stabiliser in which the two stages of the Evans circuit [see Abstract 4742 (1934)] are used with an output of from 3000 to 7000 V constant to from 0·2 to 0·5 V. AUTHOR.

4657. Electronic Conductivity in Dielectrics at High Field Strengths. T. Wolkenstein. *J. Techn. Phys. U.S.S.R.* 9. 3. *pp.* 171–187, 1939. *In Russian.*—The author discusses qualitatively various possible mechanisms providing electronic currents in dielectrics, and considers also the theory of breakdown of dielectrics. D. S.

4658. Technique of High Temperature Conductivity Measurements on Semiconductors. A. Shulman. *J. Techn. Phys. U.S.S.R.* 9. 5. *pp.* 389–398, 1939. *In Russian.*—The author describes an experimental investigation of Fairbrother's method of measuring conductivities of semiconductors at high temperatures [see Abstract 4836 (1936)]. He finds that this method leads to erroneous results below 1300° K., on account of a current to the supports of the semiconducting probe, which is usually much greater than that to the probe itself. D. S.

See also Abstracts 4689, 4690 and
2715B. Design and Use of Potentiometers. D. C. Gall.

DIELECTRICS AND CAPACITANCE.

4659. Dielectric Polarisation of Polar Liquids. J. G. Kirkwood. *J. Chem. Phys.* 7. *pp.* 911–919, *Oct.,* 1939.—An extension of the Onsager theory of dielectric polarisation [see Abstract 4842 (1936)] is presented. The local dielectric constant is approximated by the macroscopic dielectric constant of the fluid in a region outside a molecule and its first shell of neighbours rather than in the entire region exterior to the molecule. In addition to the molecular dipole moment, the average value $(\cos\gamma)_{\text{Av}}$ of the cosine of the angle between neighbour dipoles is a determining factor. Hindered relative rotation of neighbouring molecules produces a correlation between their orientations and prevents $(\cos\gamma)_{Av}$ from vanishing. The theory is applied to liquid water under the assumption of tetrahedral coordination and directed bonds between neighbouring molecules. AUTHOR.

4660. Dielectric Constant of Space Containing Electrons. S. R. Khastgir and K. Sirajuddin. *Phil. Mag.* 28. *pp.* 532–543, *Nov.*, 1939.—Preliminary work on this subject has been described previously [see Abstract 2779 (1937)]. Measurements of the effective dielectric constant of the electronic medium in the anode-grid space of a Mullard PM14 valve were made for various ultra-high frequencies and for various anode currents. With a definite frequency, the dielectric constant ϵ of the electronic medium was found on the whole to decrease almost proportionately with the increase of the anode current. When the wave-length λ was changed, keeping the anode and screen-grid voltages and the filament current constant, ϵ was found to decrease with increase of λ up to a certain wave-length, beyond which the value of ϵ gradually increased, reaching values greater than unity and after attaining a maximum for a particular wave-length, decreasing again with further increase of λ. The wave-length for maximum value of ϵ was distinctly greater for the smaller electron concentrations. These results may be explained by resonance effects in the anode-grid circuit. Neither Benner's nor Hollman and Thomas' formula was found to agree with the experimental results, but with certain assumptions the Lorentz expression for the dielectric constant of a frictionless medium is consistent with the measurements. A. W.

4661. Parachor, Dipole Moment and Molecular Refraction of Selenophene. B. Tamamushi, H. Akiyama and S. Umezawa. *Chem. Soc. Japan, Bull.* 14. *pp.* 310–317, *Aug.*, 1939. *In German.*—The physical properties of a sample of selenophene of high degree of purity (preparation described) have been determined. The following values are recorded, density, d_4^{25} 1·6003 gm./cm^3., refractive index, n_D^{25} 1·57689, molecular refraction, MR_D 27·12, surface tension, σ^{25} 36·05 dynes/cm., temperature coefficient of molecular surface energy, k 2·98, parachor, P 200·6, dipole moment in bezene $0{\cdot}78 \times 10^{-18}$, and in hexane $0{\cdot}77 \times 10^{-18}$. Selenophene shows a similar exaltation of molecular refraction to other heterocyclic compounds, and the study of its physical properties confirms its aromatic character, already indicated by its chemical reactions. A. J. M.

4662. Dipole Moment and Structure of Isomeric Selenophthenes. B. Tamamushi, H. Akiyama and S. Umezawa. *Chem. Soc. Japan, Bull.* 14. *pp.* 318–322, *Aug.*, 1939. *In German.*—Three isomeric selenophthenes ($C_6H_4Se_2$) have been isolated, and their dipole moments have been determined. One solid isomeride (m.p. 51 – 51·5°) has zero dipole moment and is a *trans*-form, another solid isomeride (m.p. 123 – 124·5°) with dipole moment $1{\cdot}07 \times 10^{-18}$, is another *trans*-form, and a liquid isomeride with dipole moment $1{\cdot}52 \times 10^{-18}$ is the *cis*-form. The liquid form shows a depression of molecular refraction. A. J. M.

4663. Molecular Rotation and Polymorphism in *t*-Butyl Halides. W. O. Baker and C. P. Smyth. *Am. Chem. Soc., J.* 61. *pp.* 2798–2805, *Oct.*, 1939.—Polymorphism has been found and studied by means of thermal, optical and dielectric measurements in *t*-butyl chloride, bromide and iodide. Dispersion, hysteresis and supercooling effects have been interpreted in terms of possible molecular processes. Solid state transitions of the first kind are attended by supercooling when a relatively small free energy difference obtains between the metastable and the stable phases below the transition. The dielectric results indicate that this supercooling may be a function of the ordering ability of the molecules in the stable form. Rotational " premelting " before a solid state transition is analogous to the premelting found in solids near the melting point. Results with the polarising microscope establish a correlation of lattice symmetry with molecular rotational freedom, and, conversely, the isotropic lattices previously found for many organic molecules above polymorphic transitions are associated with the development of rotational freedom at such transitions. AUTHORS.

4664. Dielectric Losses in Glasses at High Frequencies. G. Skanavi. *J. Techn. Phys. U.S.S.R.* 9. 7. *pp.* 612–623, 1939. *In Russian.*—The relaxation dielectric losses due to metal ion impurities in glasses are discussed theoretically on the basis of a special model. D. S.

See also Abstracts 4427, 4475, 4658, 4676, 4677.

ELECTROCHEMISTRY.

***4665. Saturated Standard Cells with Small Temperature Coefficients. Part IV. W. C. Vosburgh, P. F. Derr, G. R. Cooper and B. Pettengill.** *Am. Chem. Soc., J.* 61. *pp.* 2687–2689, *Oct.*, 1939.—Modified Weston cells were prepared in which the electrolytes were saturated with two sulphate phases, one phase being either hydrated $CdSO_4$ or a double salt of $CdSO_4$. These cells were measured at different temperatures. The temperature coefficient of the cell containing Li_2SO_4 was such that if made with Cd-Bi amalgam it would have a temperature coefficient less than that of the Na_2SO_4 cell previously reported. A number of the Li_2SO_4 cells with ternary amalgams were not as constant or reproducible as the Na_2SO_4 cell. Further observations on the constancy and reproducibility of the Na_2SO_4 cell are reported. [For Part III see Abstract 2204 (1939).] AUTHORS.

4666. Electrostatic Effects on Ionisation Constants. E. C. Baughan. *J. Chem. Phys.* 7. *pp.* 951–958, *Oct.*, 1939.—The equation of Born for the self-energy of an ion is applied to the heats of ionisation of acids and bases, following a treatment by Gurney [see Abstract 4216 (1939)]. In this way the variations in these heats with temperature are quantitatively explained, and approximate ionic radii predicted. Further applications to the ionisation of amino acids and the variation of dissociation constants as between different solvents are discussed. AUTHOR.

4667. Electrolysis of Molten Potassium Cyanate. A. Perret and J. Riethmann. *Comptes Rendus*, 209. *pp.* 595–597, *Oct.* 16, 1939.—When fused potassium cyanate (at 340°) is electrolysed the first formed ions react with the undecomposed KCNO, the reaction at the kathode being $KCNO + 2K = K_2O + KCN$, and then $2KCNO + K_2O = K_2NCN + K_2CO_3$, the latter reaction being the slower. At the anode $2KCNO + 6(CNO)' = 2KN(CN)_2 + 4CO_2 + N_2$. The $KN(CN)_2$ partially polymerises to K-tricyanomelamine. C. A. S.

4668. Silver and Mercurous Iodide Electrodes. W. C. Vosburgh, P. F. Derr, G. R. Cooper and R. G. Bates. *Am. Chem. Soc., J.* 61. *pp.* 2592–2594, *Oct.*, 1939.—The cell $Ag/AgI, I^-/I^-, Hg_2I_2/Hg$ was found to be not as reproducible or constant as experience with the two electrode systems in other cells would lead one to expect, but the most probable value based on a large number of cells leads to an approximate value for the AgI electrode. The trouble with the silver-mercurous iodide cell may be summarised by saying that while each of the electrode systems

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is highly reproducible under favourable conditions, no single electrolyte was found that did not affect one or the other of the electrodes unfavourably. AUTHORS.

4669. Thermodynamic Study of Pb-Sb System. H. Seltz and B. J. DeWitt. *Am. Chem. Soc., J.* 61. *pp.* 2594–2597, *Oct.*, 1939.—The activities and relative heat contents of Pb and Sb in their liquid alloys have been determined. The eutectic temperature for the system has been shown to be 250° and the eutectic composition 12·1% Sb. The eutectic solids have been calculated to have the compositions 3·86% Sb for the α-phase and 4·51% Pb for the β-phase. AUTHORS.

See also Abstract 4474, and

2495B. Mechanism of Reaction of Lead Storage Cell. M. de K. Thompson.
2496B. Influence of Sb in Grid Alloy of Lead Accumulator. P. Mourot.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

4670. "Protidons." E. Sevin. *Comptes Rendus*, 209. *pp.* 432–434, *Sept.* 4, 1939.—Agreement with the experimental results on the nature and distribution of the material particles which penetrate our atmosphere can be obtained by studying the action on atomic nuclei of photons of energy corresponding to the fundamental equation given by the author [see Abstract 2415 (1939)]. Study of the energy of the primary photons enables the author to work backwards to the origin of the penetrating particles and, assuming that two particles of opposite sign are produced, to predict the most simple quantum structure, and hence the most probable mass of the particles, which turns out to be 205·5 times that of the electron. A series of other possible values is also given, which includes *inter alia* the mass of the proton. Since positive or negative values are possible, experimental search for the negative proton should be prosecuted. It is suggested that the particles, being derived from protons by the action of primary photons, should be named "protidons." A. HU.

4671. Diffusion of Neutrons Produced in the $^{12}C + ^{2}D = ^{13}N + ^{1}n$ Reaction. E. Amaldi, D. Bocciarelli, F. Rasetti and G. C. Trabacchi. *Ricerca Scientifica*, 10. *pp.* 633–637, *July-Aug.*, 1939.—Measurement is made of the effective cross-section of many elements for the diffusion of neutrons of 0·1 to 0·2 eMV emitted in the reaction $^{12}C + ^{2}D = ^{13}N + ^{1}n$. The cross-section increases with the atomic number but no simple relation has been established. F. C. C.

4672. Scattering of Neutrons by Protons. C. Kittel and G. Breit. *Phys. Rev.* 56. *pp.* 744–749, *Oct.* 15, 1939.—Expansions for the computation of *s* wave scattering for square wells are arranged in a form convenient for numerical substitution. Effects of *p* wave scattering are estimated using Bethe's neutral form of meson theory. It is found that effects of the order of 50 % in the angular distribution may be expected for 16-eMV neutrons. [See Abstract 3012 (1939).] AUTHORS.

4673. Intensities of Electron Diffraction Rings. M. Blackman. *Roy. Soc., Proc.* 173*A*. *pp.* 68–82, *Nov.* 10, 1939.—The reflection of electrons by a thin film is examined from the point of view of the dynamical theory in the Laue case. The formulæ are used to obtain a criterion which determines when the scattering is sufficiently small to allow the kinematical theory to be applied; it is found that this theory is not, in general, applicable to the thin films used in work with fast electrons. The total intensity scattered from a film when it is turned through its range of reflection is also found, and the result is used to obtain an approximate intensity function showing how the intensities of the diffraction rings from a polycrystalline film will vary when the scattering is sufficiently large for the kinematical theory to be inapplicable. This intensity function is tested by comparing it with the experimental intensity function found for Cu and Ag. It is found possible to obtain a good fit with very reasonable assumptions as to the average crystal size. AUTHOR.

4674. Secondary Electron Emission. I. Pesjatzkij. *J. Techn. Phys. U.S.S.R.* 9. 3. *pp.* 188–193, 1939. *In Russian.*—Electrons of energies up to 4800 eV were directed on metal foils of order 10^{-6} cm. thick, and the secondary electron emission from the reverse side of the foils was investigated. The number of these electrons increased with the primary electron energy, and with decrease of the foil thickness, and could be made greater than the number of primary electrons. D. S.

4675. Secondary Emission under Influence of Two Electron Beams. J. Kushnir and V. Miljutin. *J. Techn. Phys. U.S.S.R.* 9. 4. *pp.* 267–270, 1939. *In Russian.*—The authors investigated the secondary emission from various surfaces due to simultaneous bombardment by two electron beams. In the case of a silver surface the emission was the sum of the emissions caused by the beams acting separately, but slight deviations from additivity were observed with oxidised surfaces. [See Abstract 2574 (1925).] D. S.

4676. Secondary Electron Emission from Thin Dielectric Layers. M. Vudynskij. *J. Techn. Phys. U.S.S.R.* 9. 4. *pp.* 271–274, 1939. *In Russian.*—The secondary electron emission from thin deposited layers of NaCl and KCl was measured in dependence on film thickness and temperature. The energy of the primary electrons was 600 eV, and a maximum secondary emission was found for thickness $\sim 10^{-6}$ cm. [See following Abstract.] D. S.

4677. Secondary Emission from Thin Dielectric Layers. A. Korshunova and N. Khlebnikov. *J. Techn. Phys. U.S.S.R.* 9. 10. *pp.* 860–869, 1939. *In Russian.*—Experiments are described which show that thin layers of KCl (optimum thickness 3×10^{-5}cm.) give large secondary emission, confirming the result of Bruining and de Boer [see Abstract 3251 (1937)]. From their experiments the authors conclude that the influence of external factors (the conditions of electron bombardment and temperature) is due to changes they produce in the structure of the layer. [See preceding Abstract.] D. S.

4678. Nature of Secondary Emission from Compound Kathodes. N. Morgulis. *J. Techn. Phys. U.S.S.R.* 9. 10. *pp.* 853–859, 1939. *In Russian.*—The author gives a theoretical discussion of the high secondary emission from compound kathodes (such as the silver, cæsium oxide type). D. S.

4679. Secondary Emission of W, Cu and Fe at High Voltages. V. Rakov and V. Antonov. *J. Techn. Phys. U.S.S.R.* 9. 10. *pp.* 870–875, 1939. *In Russian.*—The secondary electron emission from W, Cu and Fe was studied for primary electron energies from 5 to 75 ekV. The coefficients of secondary emission were found to decrease with primary electron energy over this range, becoming constant at the highest energies, and to increase with the atomic number of the metal. A detailed study was made of the distribution of velocities and directions of the secondary electrons in the case of W. [See also Abstract 1685 (1928).] D. S.

✱4680. Million-Volt Neutron Generator. E. Amaldi, D. Bocciarelli, F. Rasetti and G. C. Trabacchi. *Ricerca Scientifica*, 10. *pp.* 623–632, *July–Aug.*, 1939.—The construction and operation of the first Italian million-volt neutron generator is described. The apparatus is based on the well-known principles used by Cockcroft and Walton. F. C. C.

✱4681. Production of Beam of Fast Neutrons. P. C. Aebersold. *Phys. Rev.* 56. *pp.* 714–727, *Oct.* 15, 1939.—Well-defined, intense beams of fast neutrons have been produced by using shields of paraffin and lead in conjunction with the 8-eMV deuteron-Be source of a cyclotron. Essentially, the beam is delimited by an outward tapering channel through a wall of paraffin (or water) over 50 cm. thick. Accompanying γ-radiation was greatly reduced by lining the channel with 3 cm. of lead and by walling the outside of the hydrogenous shield with over $2 \cdot 5$ cm. of lead. γ-rays from the source are suppressed by a 3-cm. thick lead filter in the channel. Ionisation measurements and photographs showed that the fast neutron effects are mainly localised to a collimated beam which radiates out along the projection of the aperture through the lead channel. To distinguish between neutron and γ-radiations the responses of small ionisation chambers with different walls were studied. The ionisation produced by the fairly uniform background of γ-radiation is only a few per cent of that caused by fast neutrons in the beam. With an ordinary deuteron current of 60 μA the ionisation produced in air at the beam outlet by fast neutrons alone is $1 \cdot 14$ e.s.u. /cm^3. per min. To produce a neutron beam of this intensity would require a Rn-Be source of over 10^5 curies. The beam was found suitable for many physical and biological experiments. AUTHOR.

4682. Electron Space Charge between Plane Electrodes. M. J. O. Strutt and A. van der Ziel. *Physica*, 6. *pp.* 977–996, *Oct.*, 1939. *In German.*—Calculations are made relative to the space charges between plane electrodes, taking account of the initial velocity and the velocity distribution of the electrons. The components of the electron velocity are assumed perpendicular to the planes of the screen grid and the anode only. It is also assumed that there is no secondary emission, that no electrons revolve about the screen grid, that potentials and currents are stationary and that the screen grid and anode have known positive potentials. An exact solution of the fundamental differential equations is not possible and hence a numerical solution is given, which is illustrated graphically. Discussion of the results obtained shows that the chief difference from previous treatments neglecting the electron velocity distribution lies in the fact that the double valued regions of the characteristic curves are smaller in the present case and diminish with increasing width of the velocity distribution. The results are applied to the case of a diode and Langmuir's equation is derived as a first approximation. A. W.

See also Abstracts 4434, 4466, 4534, 4548, 4550 and
2522B. Present State of the Knowledge of Neutrons. B. Pontecorvo.
2537B. Space-Charge Effects in Electron Beams. A. V. Haeff.
2538B. Spherical Aberration of Magnetic Lenses. H. Becker and A. Wallraff.

ELECTROSTATICS.

✱4683. Simple Vacuum Electrometer. I. Backhurst. *Journ. Sci. Instruments*, 16. *pp.* 347–353, *Nov.*, 1939.—Details including scale drawings are furnished for the construction of a vacuum electrometer requiring no fine adjustment device other than that afforded by the levelling screws. An outline of the theory is given together with experimental data in illustration, which show that the effect of asymmetry may be varied over an adequate range by means of slight tilting of the instrument. A method of construction is described which with the aid of exterior heat screens minimises heat convection and thermal and contact e.m.f.s and so secures satisfactory zero stability. The electrical capacity when used with the vane at fixed potential is made sufficiently low to render unnecessary for most purposes the more complicated method of working with fixed quadrant potentials. Reliability, ease of operation and adjustment, together with good zero stability, are the principal features claimed for this design of the instrument, which, by choosing Wollaston strip of appropriate size, may be made to cover any range of sensitivity required up to the limit set by Brownian motion or mechanical vibration. AUTHOR.

***4684. Improved Method of Making Permanent Electrets and Factors which Affect their Behaviour. W. M. Good and J. D. Stranathan.** *Phys. Rev.* 56. *pp.* 810–813, *Oct.* 15, 1939.—A method is described for making strong, smooth, and uniform electrets. The study concerns both the mixing of the carnauba wax and rosin of which the electret is made, and the manner of cooling in the electric field. The electret was cooled in a heavy iron cylinder placed in an oil bath whose rate of cooling was controlled automatically. Electrets were made for which the time of cooling ranged from 30 min. to 10 days. Observations made on some 35 electrets seem to justify the following conclusions : (1) Electret behaviour depends markedly upon details of preparation of the carnauba wax-rosin mixture. The time required for reversal of the electret's charge is increased by mechanical mixing of the components, by heating to a high temperature for a short time, or by heating to a somewhat lower temperature for a longer time. (2) Extending the cooling time in the electric field beyond a day produces little effect. Below this there exists a range of cooling times vital to the behaviour of the electret. Those cooled in the open air in the customary manner reverse sign in a shorter time than do those cooled within the cylinder. X-ray photographs show a structural difference between these. (3) Alignment of crystals, as judged from X-ray studies, has little to do with the final charge density attained by the electret. Many samples which are electrets show no alignment. (4) The behaviour of the carnauba wax-rosin electret is that of carnauba wax physically modified by the presence of the rosin.

AUTHORS.

See also Abstracts 4666, 4699.

MAGNETISM AND ELECTROMAGNETISM.

4685. Wave-Propagation Phenomenon. M. Parodi. *J. de Physique et le Radium*, 10. *pp.* 399–402, *Sept.*, 1939.—The author studies the propagation of an oscillatory disturbance along a line of bar magnets. By transposition to atomic magnitudes and quantification of the waves an explanation is obtained for certain classical phenomena in ferromagnetic media at low temperatures. [See also Abstract 1737 (1939).]

G. E. A.

4686. Curie Constant and Curie Point in Ni Alloys. K. F. Niessen. *Physica*, 6. *pp.* 1011–1033, *Oct.*, 1939. *In German.*—Following the Slater theory of ferromagnetism, the Curie constant (c) and Curie point (θ) of a Ni alloy are taken as functions of the content ($100x$ %) of the added metal, and attention is drawn to effects which influence the values of dc/dx and $d\theta/dx$ when x is zero. Two cases are investigated which differ in this respect that in one case it is assumed that all gaps for the alloy occur in the 3*d*-Ni band, whereas in the other case the possibility of a distribution of the gaps over the 3*d* band of both Ni and Cu is considered. It is supposed that with Ni–Cu and Ni–Zn the gaps are present in both bands, but that with alloys of Ni and high valency elements the gaps exist only in the Ni band. Reasons for the adoption of the supposition are given. G. E. A.

*4687. **Magnetic Measurements on Long Rods. H. Schmidt-Glenewinkel.** *Phys. Zeits.* 40. *pp.* 519–533, *Aug.* 15, 1939.—Alloys used for precision scales and for pendulums of precision clocks are usually not homogeneous, and magnetic tests on small samples are therefore useless. Ballistic measurements on rods more than 1 m. long and of considerable cross-section are described in which the self-demagnetising field is measured by means of thin search-coils wrapped as closely as possible round the specimen. Values of the demagnetising coefficient deduced, when extrapolated to zero susceptibility, agree well with calculated values. A definition of " dimension-ratio " for prismatic bars is suggested which gives results consistent with those for cylindrical rods. No effect of absolute dimensions on the demagnetising coefficient, as found by Shuddemagen [see Abstract 1502 (1910)], is observed. Results are given for a number of special alloys, ferrous and non-ferrous, particularly those having small coefficients of expansion, and the influence of the magnetic properties of Ni-Fe alloys used in pendulums on the operation of precision clocks is discussed. C. E. W.

4688. H.F. Magnetic Permeability of Iron. D. Mash. *J. Techn. Phys. U.S.S.R.* 9. 4. *pp.* 339–342, 1939. *In Russian.*—The h.f. magnetic permeability of Armco iron spheres was measured by the heating effect, for a wave-length of 4·45 m. It was about 30 times less than the static permeability, but showed a maximum for about the same value of field (~ 1 gauss) and was independent of the size of sphere used. D. S.

4689. Distribution of Induced Currents in a Plate. N. Shilov. *J. Techn. Phys. U.S.S.R.* 9. 7. *pp.* 624–632, 1939. *In Russian.*—The author calculates approximately the distribution of induced currents in a cracked plate in an alternating magnetic field perpendicular to the plate. The results are found to be in reasonable agreement with experiment. [See following Abstract.] D. S.

4690. Distribution of Induced Currents in a Circular Cylinder. N. Shilov. *J. Techn. Phys. U.S.S.R.* 9. 7. *pp.* 633–643, 1939. *In Russian.*—The author calculates the distribution of induced currents in a circular cylinder in an alternating magnetic field parallel to the axis. The effect of cracks in the cylinder is discussed, and the results are compared with experiment. [See preceding Abstract.] D. S.

4691. Magnetostriction. D. S. Subbaramaiya. *Current Science,* 8. *pp.* 403–407, *Sept.*, 1939.—The phenomena which have been grouped together under the heading " Magnetostriction " are briefly described. Experimental results on the magnetostriction of ferro-, para- and diamagnetic substances, single crystals and alloys are considered and the theoretical importance of the phenomenon pointed out. The development by Pierce of the magnetostriction oscillator and its importance as a frequency standard is indicated. Use of oscillators of very high amplitudes in the laboratory for the investigation of physico-chemical problems and their important industrial applications are mentioned. The article is in the nature of a review of the recent progress made in this subject which has become one of great importance. AUTHOR.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4692. Stereoroentgenoscopy using Polarisation. W. Snow. *Am. J. of Roentgenology and Radium Therapy*, 42. *pp*. 143–144, *July*, 1939. —Previous investigations of stereoscopic X-ray screen devices are mentioned. The author has attempted to solve the problem by use of two X-ray tubes and a system of light polarising screens placed before the X-ray fluorescence screen, resulting in vertical and horizontal polarisation of the fluorescent light. Vision is by means of a special pair of spectacles, one lens giving horizontal and one vertical polarised vision, according with the varying phase. As with all other methods of stereoscopic screen vision, the device is more effective for thin rather than thick body parts. This is considered to be due to a lag effect, which it is hoped further to investigate and eliminate. B. J. L.

4693. Relation between Tin and Copper Filtration for Thick-Walled X-Ray Tube. M. C. Reinhard and H. L. Goltz. *Am. J. of Roentgenology and Radium Therapy*, 42. *pp*. 122–124, *July*, 1939.—Thoraeus has shown that by use of tin instead of copper filters in X-ray treatment, there is a resulting increase of effective radiation of 25%, with thin-walled glass X-ray tubes. The authors investigate this question in respect to thick-walled glass tubes and show a resulting superiority of tin of 13% for X-rays generated at 200 kV. Graphical and tabular data are given, showing that the superiority of tin filtration increases in relation to the half-layer value, *i.e.*, for a beam having a half-layer value of 1·23 mm. copper the superiority of tin filtration is 4·9% whereas, for a beam having a half-layer value of 2·66 mm. copper, the use of tin filtration increases the effective radiation to 38·5%. B. J. L.

***4694. Universal Dosimeter and Ultrasensitive Valve Electrometer. G. Bucky.** *Am. J. of Roentgenology and Radium Therapy*, 42. *pp*. 428–435, *Sept.*, 1939.—The author has developed a device to allow sufficiently accurate rapid measurements of dosage for practical purposes. In this device a small ionisation chamber, subjected to the X-rays, disturbs the grid charge of a thermionic valve, with resulting variation of anode current. To obviate external disturbances, a balanced pair of valves are used in a Wheatstone bridge arrangement. An advantage of the balanced instrument is that, owing to the null method employed, no visible reading is given when radiation is not applied, or if the apparatus is not properly compensated. The instrument is described and illustrated and can be adjusted for three ranges of dosage. It can be arranged to operate a relay to stop operation of the X-ray tube when a pre-selected dosage has been given. Other possible applications of the apparatus are for measurement of the degree of ionisation of the air, measurement of fluorescence by use of a photo-cell, measurement of conductivity of insulators such as oils and the testing of metal castings. B. J. L.

4695. Economic Features of X-Ray Protection. L. S. Taylor. *J. of Applied Physics*, 10. *pp*. 598–603, *Sept.*, 1939.—Basic rules have been formulated by the International Commission on X-Ray and Radium Protection. In the present paper the application of these rules is analysed from the practical and economic points of view. Curves are given from which the combined protective effects of distance and barriers of lead can be estimated in any particular case, the use of the curves being illustrated by examples. Comparative protective values of lead and concrete are tabulated together with estimates of cost of installation for kilovoltages between 100 and 1000. Modifications in the standard amounts of protective materials for scattered radiation are discussed. J. E. R.

4696. Radium Protection. E. H. Quimby. *J. of Applied Physics*, 10. *pp.* 604–608, *Sept.*, 1939.—The dangers to health attendant on continued exposure to low intensity γ-rays are discussed in some detail. The most effective protective factor is the inverse square law, but in addition barriers of lead are often required. A chart is given showing the thicknesses of lead necessary over a wide range of conditions. In some cases, materials other than lead can be used, and comparative figures are given for iron, barium plaster, concrete and brick. The dangers of protecting against direct radiations, whilst neglecting scattered radiations are stressed. J. E. R.

See also Abstract 4617.

OSCILLATIONS AND WAVES.

***4697. Beam Tubes as Ultra-High Frequency Generators. R. King.** *J. of Applied Physics*, 10. *pp.* 638–647, *Sept.*, 1939.—The operation of beam power tubes in regenerative e.h.f. oscillators is investigated experimentally. Wave-length characteristics of oscillating 6Y6-G and 6V6-G tubes are displayed and compared with a corresponding curve for a type 56 triode. Wave-lengths as low as 150 cm. were obtained. Current and wave-length characteristics of the oscillating 6Y6-G are given as functions of plate, screen and control grid voltages. The efficiency of the generator is investigated near its lowest wave-length limit. Means for preventing oscillation in amplifier circuits using beam tubes are suggested. [See Abstract 1397B (1938).] AUTHOR.

4698. Electric Oscillations in a Triode with Insulated Grid. R. Fortrat and A. Caravel. *Comptes Rendus*, 209. *pp.* 554–556, *Oct.* 9, 1939.—As the anode p.d. is raised, the V_A/I_A curve first is the same as with the grid connected to negative of kathode (directly heated); but above 775 V (in this example) the anode current jumps to near saturation. The authors have established that in this régime an oscillatory current is present (probably a relaxation oscillation), its frequency being of the order of 250 Mc/sec. R. M.

4699. Theory of Triode as 3-Body Problem in Electrostatics. A. Marcus. *Am. Phys. Teacher*, 7. *p.* 196, *June*, 1939.—If V_1, V_2, V_3 are the potentials of the grid, kathode and anode respectively, in a triode having a cold kathode, the corresponding charges are given by equations such as $q_2 = c_{21}V_1 + c_{22}V_2 + c_{23}V_3$. If V_2 is kept constant, it follows that $\Delta V_3/\Delta V_1 = c_{21}/c_{23}$ the magnification factor, and there is no restriction of the position of the grid, which need not be between kathode and plate. Further, it follows that the electric field at the kathode is always increased when the grid potential increases, irrespective of the position of the grid. [Remarks by **P. L. Copeland**, *ibid. p.* 346, *Oct.*, 1939.] J. P. A.

***4700. Negative-Feedback Linear-Pulse Amplifier. R. C. Waddel.** *Rev. Sci. Instruments*, 10. *pp.* 311–314, *Oct.*, 1939.—A linear pulse amplifier is described which uses the principle of negative feedback. The amplifier is substantially unaffected by changes in supply voltages and provides either positive or negative output pulses with practically exact linearity and little backwave. The circuit components are easily obtainable and of moderate cost. A mechanical design is suggested which minimises the labour of construction. AUTHOR.

4701. Electromagnetic Waves in Lines with Rectangular Screens. J. Feld. *J. Techn. Phys. U.S.S.R.* 9. 7. *pp.* 587–600, 1939. *In Russian.*—The author develops the general theory of propagation of electromagnetic waves in asymmetrical double lines and single lines, enclosed in screens of rectangular cross-section. Assuming the lines and screen to be perfect conductors, general formulæ are deduced for the field inside the screen, the currents and charges. Finally formulæ are given for computing the wave resistances of the lines. D. S.

***4702. Piezoelectric Oscillograph. V. Kazansky.** *J. Techn. Phys. U.S.S.R.* 9. 8. *pp.* 673–679, 1939. *In Russian.*—The construction is described of a piezoelectric oscillograph for recording high voltages without appreciable use of current. The sensitivity at 12 kV was 256 V/mm., and was independent of frequency up to 7 kc./sec. [See Abstracts 693B (1925) and 1609B (1932).] D. S.

See also Abstract 4660 and

2531B. Frequency Meter of the Compensation Type. E. Kaden.
2649B. Interference to Radio Transmission and Eruptions in the Sun. B. Beckmann.
2777B. Heights of Reflecting Regions in the Troposphere. A. W. Friend and R. C. Colwell.

PHOTOELECTRICITY.

***4703. Photo-Emission in Geiger-Müller Counters. S. C. Curran and J. E. Strothers.** *Cambridge Phil. Soc., Proc.* 35. *pp.* 654–657, *Oct.*, 1939.—The recent theory of the action of tube counters in terms of photo-emission is applied to alcohol-argon filled counters, and some experimental results are given which indicate that the photoelectric yield in this type of counter is much less than in the older type. For this reason the pressure must be kept low and the wall area large. The smaller value for the extinction time is also discussed. W. E. D.

4704. Compound Photokathodes. N. Khlebnikov and N. Zaitzev. *J. Techn. Phys. U.S.S.R.* 9. 1. *pp.* 44–62, 1939. *In Russian.*—From experimental investigations on the photoelectric properties of Sb-Cs and similar kathodes it is concluded that the Sb-Cs forms a semiconducting layer with an internal photoelectric effect. [See Abstract 4412 (1936) and following Abstract.] D. S.

4705. Photo-Cells with Sb-Cs Photokathodes. N. Zaitzev. *J. Techn. Phys. U.S.S.R.* 9. 8. *pp.* 661–672, 1939. *In Russian.*—Continuing previous work of the author and N. Khlebnikov [see preceding Abstract], further experimental support is found for the conclusion reached. The influence of various technical factors in the preparation of the kathodes on their integral sensitivities is examined. Various constructions of photo-cells made possible by the special properties of the Sb-Cs kathodes are described and their performances discussed. D. S.

See also Abstracts 4454, 4678.

PIEZOELECTRICITY.

See Abstracts 4458, 4702.

THERMIONICS.

See Abstract 4682.